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SOME PHILIPPINE SPECIES OF THE GENUS *MUSCA* LINNÆUS

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In August, 1922, during my visit to Prof. M. Bezzi at Turin, he very generously gave me a large collection of species of *Musca* from the Philippine Islands to describe. The specimens, 151 in number, were collected by Prof. C. F. Baker, in the vicinity of Los Baños, Laguna Province, in Baguio, Benguet Subprovince, Luzon, and in two localities in Mindanao; by Mr. R. C. McGregor in Panay and Batbatan Islands; and by Mr. M. B. Mitzmain in Alabang, Rizal Province, Luzon. The specimens collected by the latter are of peculiar interest, as some of them are the hæmatophagous species referred to in his well-known investigations into the method of transmission of the trypanosome of surra in the Philippine Islands. I believe they were caught on animals in association with biting flies such as *Stomoxys calcitrans*. Bezzi¹ has already recorded two species of *Musca*, *M. crassirostris* Stein and *M. inferior* Stein, from these Islands. In addition, *M. conducens* Walker, *M. niveisquama* Thomson, *M. bivittata* Thomson, and *M. favillacea* Walker have also been recorded from the Philippines. As these Islands form a part of the Oriental Region, it is only natural to expect that the species of this genus, as Professor Bezzi has pointed out in the case of other dipterous genera, would be to a large extent identical with those from other parts of the

¹ Philip. Journ. Sci. § D 8 (1913) 305.

Region, and the present collection clearly shows this to be the case.

As I have now studied nearly all the existing types of the genus *Musca*, I am in a position to give the species their correct and final names, as well as all the synonyms. In studying any large collection of species of this genus it is not only convenient but also most satisfactory to deal with them in three groups, into which they naturally fall as follows:

GROUP I

The nonbiting, occasionally hæmatophagous, true house- and bazaar-frequenting species, which, though often found on animals, are mainly associated with man, his dwellings, and his food. They breed in garbage and excrement of all kinds and regularly feed on these. It is hardly necessary to point out that the species of this group are some of man's most-dangerous insect pests; but, unfortunately, we are not able to gauge with any degree of accuracy the amount of harm they do. Although no one has yet succeeded in isolating known species of pathogenic bacteria from wild specimens (that is, flies caught in houses and bazaars), practical experience has taught us to regard them as certain carriers of pathogenic bacteria, helminth eggs, and parasitic protozoa from excrement to the human body and to food of all kinds. More than one species is the invertebrate host of species of *Habronema* parasitic in horses and cattle.

GROUP II

The nonbiting, hæmatophagous species comprising this group are only found on animals and in their vicinity, and breed almost exclusively in cow dung. There is very little doubt that the species of this group are mechanical carriers of blood parasites and bacteria from one animal to another. Anyone who has observed their habits in the field will be in a position to appreciate their potentialities in this direction. Representatives of this group are to be found in most parts of the world feeding on cuts, abrasions, wounds, sores, and the discharge from the eyes of animals, as well as on the blood and serum which exude from the bites of true biting flies. Owing to the nature of their food, these species are essentially intermittent feeders and may be seen flitting from one animal to another in search of food. But here again Mitzmain has shown that some of them are certainly under suspicion as carriers of pathogenic trypanosomes, but there is at present no experimental proof that they

are the vectors. Several species are known to be suitable invertebrate hosts of species of *Habronema*, and the evidence so far seems to point to their being the transmitters of these helminths to equines and bovines. They should always be taken into consideration when investigating an outbreak of any parasitic disease among animals, and are therefore of importance in veterinary medicine.

GROUP III

This group consists of the true biting-blood-sucking species which are only found on animals and in their vicinity, and which breed exclusively in cow dung. Although there is no experimental or other evidence to show that any of the species of this group are associated in the transmission of disease-causing organisms to animals, as blood-sucking flies they must be looked on with suspicion.

I will now deal with the species according to the groups to which they belong and in the above order.

SPECIES OF GROUP I

Musca vicina Macquart.

Musca flavinervis Thomson.

Musca atrifrons Bigot.

Musca flavifacies Bigot.

Musca flavipennis Bigot.

? *Musca biseta* Hough.

? *Musca divaricata* Awati.

Musca determinata Patton (nec Walker).

The collection contains 5 males and 3 females from Manila (McGregor) and 2 males and 8 females from Alabang, Rizal Province, Luzon (Mitzmain). The specimens, with the exception of one female, agree with Macquart's types of *Musca vicina*, and are the species referred to by me in a recent paper as *Musca domestica* (atypical), in which the male has a very much narrower front than the typical *domestica* L. In that paper I expressed the opinion that the following were probably also this species:

Musca sanctae-helenae Macquart, Saint Helena.

Musca lateralis Macquart, Mauritius.

Musca basilaris Macquart, Brazil and Mexico.

Musca frontalis Macquart, Chili.

Musca analis Macquart, Chili.

Musca consanguinea Rondani, Mexico.

Musca senegalensis Macquart, Senegal.

Musca flavinervis Thomson, Ross's Island.

Musca antiquissima Walker, Australia.

Musca calleva Walker, South Africa.

Musca vicaria Walker, New Zealand.

Musca pampasiana Bigot, Buenos Ayres.

I have since examined the type of *Musca flavinervis* Thomson at Copenhagen, and find it is this species, thus confirming my previous determination. But a reëxamination of Bigot's and Walker's types has led to the final conclusion that *M. antiquissima*, *calleva*, *vicaria*, and *pampasiana* are identical with *M. domestica* L. I was unable to find the types of either Macquart's *M. sanctae-helenae*, *lateralis*, *basilaris*, *frontalis*, or *analis* in Paris, and therefore I propose finally deleting these names from the literature, for it is quite impossible to be certain what they are, from Macquart's commonplace descriptions. I have not seen the type of *M. consanguinea*, but Professor Bezzi tells me it is *M. domestica* L. I have also not as yet seen the type of *Musca biseta* Hough, which I believe is in Philadelphia. I have been unable to find out where the type of *M. divaricata* Awati is, and, unless it is forthcoming, I propose dropping this name later. As *M. vicina* is the oldest name of this species, the type of which I have seen, I propose adopting this name in future for the species of *Musca* which is like *M. domestica* L., but in which the male has a much narrower front.

Musca vicina is widely distributed in the Tropics, and is a common house fly. The male is easily distinguished from that of *M. domestica* L., by its narrower front, which is about one-seventh to one-eighth the width of the eye, and about half that of *M. domestica*. The female is very like that of *domestica* and difficult to distinguish from it, but the parafacials are a little wider and the frontal stripe is distinctly narrower; the apparent first and second abdominal segments, especially the former, are lighter orange than those of *domestica*, in which they are usually dark brown or black. One female in the collection is indistinguishable from the European *domestica*, and it is very probable that this species occurs in the Islands. A more extensive collection of house and bazaar flies would be of great interest in this direction.

Musca nebulosa Fabricius.

Musca determinata Walker.

? *Musca multispina* Awati.

There are 3 males of this widely distributed Oriental species in the collection, 2 from Alabang, Rizal Province (*Mitzmain*),

and 1 from Manila (McGregor). I have always been doubtful as to the accuracy of the determination of this species with the *M. nebulo* of Fabricius, and hoped to have settled my doubt one way or the other by an examination of the type at Kiel. The type of *M. nebulo* has, however, shared the fate of the rest of the collection of Fabricius, and is now only represented by a pin and a label. It is quite impossible to be certain as to what Oriental species Fabricius had before him when he wrote his very inadequate description and, when on my way to Copenhagen from Kiel, I had decided finally to delete this name from the literature and to rename the species *M. determinata* Walker. When I came to examine the Fabrician collection at Copenhagen, I found two specimens, one a male and the other a female, bearing the label *nebulo*, in the handwriting of Fabricius; the former is the common Oriental house fly, but the latter is *M. humilis* Wiedemann. I therefore propose retaining the name *nebulo* finally for the common Oriental house fly. I have no knowledge of the whereabouts of the type of *M. multispina* Awati.

Musca nebulo may be confused with *M. vicina*. The frons of the male is about as wide as that of *M. vicina*; but, whereas the orbital margins of the latter are parallel almost to the vertex, those of the former curve in just above the middle so that the frons is distinctly waisted just below the vertex. The abdomen of *M. nebulo* is lighter, especially the apparent third segment; in *M. vicina* the abdomen is dark orange, and the third segment has a dark brown admedian stripe; the apparent fourth segment is also much darker. The female of *nebulo* is also much lighter in color than the female of *vicina*, and has well-marked silvery stripes and spots on its abdomen.

***Musca sorbens* Wiedemann.**

Musca humilis Wiedemann.

Musca spectanda Wiedemann.

Musca latifrons Wiedemann.

Musca mediana Wiedemann.

Musca sordissima Walker.

Musca primitiva Walker.

Musca angustifrons Thomson.

Musca bivittata Thomson.

Musca scapularis Rondani.

Musca euteniata Bigot.

Musca conducens Patton (nec Walker).

Musca praecox Patton (nec Walker).

The collection contains 5 males of this species, 4 from Baguio, Mount Maquiling, and Los Baños (*Baker*) and 1 from Batbatan

(McGregor); 3 females from Los Baños (Baker) and 1 from Culasi, Panay (McGregor). Since writing my notes on this species in the paper referred to above, I have examined Wiedemann's types of *Musca sorbens*, *humilis*, *latifrons*, *mediana*, and *spectanda* and find they are all identical; *sorbens*, being the oldest name, must, I regret to say, replace the well-known name *humilis*. I have also examined the types of *Musca angustifrons* and *bivittata*, and am now able to confirm Stein's determination; but the type of *niviesquama* Thomson is not *sorbens* but *vetustissima* Walker. Professor Bezzi tells me he has examined the type of *scapularis* Rondani and that it is identical with *sorbens*. *Musca sordissima*, the type of which I have examined, is also this species. I wish here to correct a mistake made in the determination of Walker's types of *conducens* and *praecox*. A re-examination clearly shows that they are not *sorbens* but the Oriental species known as *lineata* Brunetti, which name now becomes a synonym of *conducens*.

Musca sorbens is a very variable species, and these specimens from the Philippines are darker than most of the Oriental and Ethiopian specimens, and the apparent first abdominal segment of the male is dark brown. However, I have in my collection from India a long series of bred and caught specimens which exhibit variations from the light first abdominal segment to the dark brown type as seen in the Philippine specimens; many of the African specimens also exhibit this variation in color. In all other respects the present specimens are typical.

The width of the frons of the male of *Musca sorbens* is also very variable, as has already been pointed out by Stein. The females do not vary much, either in color or in structural characters; the Philippine specimens are typical.

***Musca vetustissima* Walker.**

Musca pumila Patton (nec Macquart).

Musca minor Patton (nec Macquart).

Musca humilis Stein and authors (nec Wiedemann).

Musca corvina Froggatt (nec Fabricius).

Musca niviesquama Thomson (nec Stein).

The collection contains 1 male from Los Baños (Baker), and 5 females from Alabang, Rizal Province, and Culasi, Panay (McGregor), also from Baguio and Los Baños (Baker). In my notes on the Oriental species of the genus, in the paper mentioned above, I have recorded this species under the name *Musca pumila* Macquart, but as I have been unable to find any

types of this species in Paris I propose deleting the name from the literature and, instead, naming this species *vetustissima*, the type of which I have examined. It is quite impossible to be certain of the identity of Macquart's *pumila*, from his usual commonplace description. The types of *Musca minor* Macquart are nothing more than *domestica* L.; *Musca vetustissima* has been confused repeatedly with *Musca sorbens* (*humilis*); and Froggatt has noted it under the name *corvina*, which is, however, a very different species.

The Philippine specimens of *Musca vetustissima* are darker than the Indian specimens, but here again a long series of bred specimens from India clearly demonstrates the variability of the species.

Musca vetustissima is a common bush and camp fly, and is a well-known human pest in Australia; it is believed on good evidence to be the carrier of the bacteria of infective conjunctivitis and allied conditions. Like *sorbens* it is commonly found on animals far from human dwellings, and its breeding habits are very similar. With *sorbens* it links the species of Group I with those of Group II. It can always be distinguished from *sorbens* by its bluer color and the narrower front of the male.

SPECIES OF GROUP II

Musca ventrosa Wiedemann.

Musca xanthomela Walker.

Musca nigrithorax Stein.

Musca pungoana Karsch.

? *Musca kasauliensis* Awati.

There are 2 females of this very characteristic species in the collection, 1 from Los Baños and the other from Mount Maquiling (*Baker*). I have examined the type of *Musca ventrosa*, as well as that of *M. pungoana*, and note that the latter is identical with the former. I have not yet seen the type of *M. nigrithorax* Stein, but its author states it is identical with *M. ventrosa*.

Musca ventrosa can always be recognized by its bluish thorax with four dark stripes and the bright orange abdomen without any markings. The specimens in the collection are typical.

Musca craggi Patton.

The collection contains 5 males from Culasi, Panay (*McGregor*), Mount Maquiling, Dapitan, and Puerto Princesa (*Baker*); and 6 females from Alabang (*Mitzmain*), Culasi, Panay (*Mc-*

Gregor), Los Baños, Mount Maquiling, Tacloban, and Puerto Princesa (*Baker*). This species was described recently from southern India. The male may be mistaken for a small specimen of *Musca sorbens*, but the thoracic stripes are well separated, and the median pair are always very narrow in front of the suture; this character is extremely constant in both sexes. The abdomen of the female is reddish brown with dark stripes and bands.

Musca bakeri sp. nov.

Male.—Fourteen specimens from Los Baños, Mount Maquiling, Mount Banahao, and Zamboanga (*Baker*); from Culasi, Panay, and Batbatan (*McGregor*); and from Alabang (*Mitzmain*). Average length of specimens, 8.5 millimeters. Frons very narrow, about one-fifteenth width of eye; eyes bare and almost meeting; frontal stripe a narrow black line; parafrontalia and cheeks silvery gray; antennæ and palpi black; proboscis normal.

Thorax bluish gray with four broad, black, well-separated stripes. The middle pair extend to the anterior margin of the thorax, are not interrupted at the suture, and are distinctly wider behind it; the outer pair are broad, somewhat triangular in front of the suture, and extend without interruption to the margins of the scutellum. They are wider than the presutural portion of the inner pair, and converge toward them. The scutellum is yellowish, and the median dark band is often constricted in the middle, forming two spots.

Abdomen with apparent first segment black, but in two specimens only the anterior part is black with a broad median stripe, and in a third the majority of the segment is black including the median stripe, the remaining narrow basal strip is dark brown. In spite of these marked differences I have no hesitation in saying that these three specimens are identical with the more-typical forms. Apparent second segment either light or dark brown (the latter in the majority of the specimens), with a broad black median stripe and a narrow, black, anterior band extending the length of the middle third of the segment, and a large light silvery yellow admedian spot or patch, and silvery yellow patches at the extreme edges of the tergite; apparent third segment very similar, except that the marginal patch is larger and between it and the admedian spot there is a broad, triangular, clove brown stripe, and in many

of the specimens a narrow, black, basal band; apparent fourth segment exactly similar to the third. Sternites black, forming a characteristic ventral black band which is lighter in the paler specimens noted above. Wings clear, radio-medial root vein normally with four long bristles, sometimes three or even two; and a row of bristles on the lower surface of vein R_{4+5} extending well beyond the radio-medial cross vein. Squamæ whitish yellow and bare.

Female—Twenty-six specimens from Baguio, Mount Maquiling, Los Baños, Mount Banahao, Tacloban, Dapitan, and Zamboanga (*Baker*), and from Culasi, Panay (*McGregor*). Average length of specimens, 8.5 millimeters. Frons more than half the width of the eye; frontal stripe narrow and about half the width of the frons with straight edges; parafrontals wide, silvery gray, with two rows of small bristles; vertex dark; cheeks silvery; antennæ, palpi, and proboscis as in male.

Thorax more silvery and stripes a little narrower than in the male. Abdomen grayish, and when rubbed brownish with black stripes and bands. Apparent first segment black with bluish gray admedian patches often extending almost the whole width of the segment and forming a band; apparent second segment gray with a broad median black stripe and two narrow lateral ones which broaden out at the lower border of the segment forming narrow black bands externally; in addition, a narrow black band along the anterior border of the segment; apparent third segment exactly similar but without an anterior band; apparent fourth segment yellowish gray with a broad median stripe, and often narrow lateral ones. Characters of wings, squamæ, legs, etc., similar to those of the male.

I have much pleasure in naming this striking species in honor of Prof. C. F. Baker, who has contributed much to our knowledge of the Diptera of these Islands.

Musca bakeri is closely allied to *M. bezzii* Patton and Cragg and *M. hervei* Villeneuve, recently described from Tonking and China. The male differs from that of *bezzii* by its lighter-colored thorax and narrower stripes; by the markings of the apparent first abdominal segment, which in *bezzii* always has a patch of light brown along the lower border, and which does not extend to the middle line; by the fewer number of hairs on the radial root vein (normally there are seven in *bezzii*); and by the black sternites. The female differs from that of *bezzii* by its narrower parafrontals, especially just above the level of the bases of the antennæ, and by the fewer number of hairs on the radio-medial

root vein; they are, however, difficult to distinguish. The male of *bakeri* can be distinguished from the male of *hervei* by the portions of the tergites adjoining the sternites being brown, whereas in *hervei* they are black; and in *hervei* there are no bristles along the lower border of vein R_{4+5} . Although I have seen the female of *hervei* in Doctor Villeneuve's collection, I have not studied it sufficiently closely to note how it differs from *bakeri*.

Several of the specimens of *Musca bakeri* in the collection show evidences of having ingested blood, suggesting clearly the habits of this species. I have no doubt it is the species referred to by Mitzmain in his work on surra. It would be interesting to know whether or not this species is larviparous.

The types and most of the cotypes have been returned to Professor Bezzi; I have several cotypes in my collection for further study.

SPECIES OF GROUP III

Musca conducens (Walker).

Musca praecox Walker.

Pristirhynchomyia (*Philaematomyia*) *lineata* Brunetti.

Musca humilis Patton (nec Wiedemann).

The collection contains 8 males from Los Baños and Mount Maquiling (*Baker*) and from Batbatan (*McGregor*) and 17 females from Los Baños and Mount Maquiling (*Baker*) and from Culasi, Panay (*McGregor*). The males are typical specimens of this small, very variable species, but the females are darker and have broader abdominal bands. In my paper on the Oriental species of the genus, referred to above, I stated that the types of *Musca conducens* and *M. praecox* were small examples of *M. sorbens*, but on reëxamining them and comparing them with some fresh material from India I now see that they are the species described by Brunetti under the name *lineata*. It is important to note that the thoracic stripes of the males of this species are often so close together as to appear to be united. These specimens can easily be mistaken for small examples of *M. sorbens* Wiedemann.

Musca conducens belongs to both the second and the third groups and links the two together. It is hæmatophagous and, though unable to draw blood, has well-developed prestomal teeth which are reduced in number and are certainly capable of scratching off a small scab or clot of blood.

Musca (Awatia; Philaematomyia) *planiceps* Wiedemann.*Musca cingalaisina* Bigot.*Musca pollinosa* Stein.*Philaematomyia indica* Awati.

The collection contains 2 males from Dapitan and Zamboanga, Mindanao (*Baker*), and one female from Dapitan (*Baker*). I have examined the types of *Musca planiceps* Wiedemann in Copenhagen and note that they are this common Oriental species. Though I have not seen the types of *pollinosa* Stein and *indica* Awati, I have no doubt they are identical with *planiceps*.

Musca planiceps is of peculiar interest for, though undoubtedly a bloodsucker, neither Mr. Senior-White nor myself have ever seen it sucking blood, though we have both observed its habits in the field. It is larviparous in habit and deposits one larva at a time in the early third stage.

Musca (Philaematomyia; Ptelelepis) *inferior* Stein.*Philaematomyia gurneyi* Patton and Cragg.

The collection contains 5 males from Los Baños, and Zamboanga and Davao, Mindanao (*Baker*) and 7 females from Los Baños, Mount Maquiling, and Zamboanga (*Baker*). This species is a true bloodsucker, as it is able to scratch the skin and draw blood with its prestomal teeth. It is never seen in large numbers, and when first taken by me at Kodaikanal (6,000 feet), Pulney Hills, southern India, I caught only twelve specimens. Recently Mr. Senior-White sent me a large number collected at the Government Dairy Farm, Colombo, where it is apparently a common species. Mr. Senior-White has found its larva in cow dung, but never in large numbers, clearly suggesting it is larviparous in habit. I have no information as to whether or not the Philippine specimens were caught on cattle in the act of sucking blood.

Musca inferior can be easily recognized by the presence of hairs on the dorsal and middle aspect of the squamæ.

Musca *crassirostris* Stein.*Musca modesta* de Meijere.*Philaematomyia insignis* Austen.

The collection contains 1 male and 3 females from Baguio, Benguet Subprovince, 3 females from Los Baños, Luzon, 1 female from Tacloban, Leyte, and 1 male from Cagayan, Mindanao (*Baker*); 1 female from Davao (*Baker*); and 1 male from Culasi,

Panay (McGregor). The specimens agree in every detail with those from other parts of the Oriental and Ethiopian Regions. I have no doubt that this is Stein's species *crassirostris*, but I hope soon to have the opportunity of examining the type and settling this point. With Professor Bezzi, I came to the conclusion that *Musca modesta* de Meijere from Java is also this species, and Professor de Meijere tells me that this is the case, and that Stein had also come to the same conclusion. I have examined the type of *insignis* and there is no doubt that it is identical with *crassirostris*.

Musca crassirostris can be easily recognized by its dark gray or olive-green to blackish coloration; by its narrow thoracic stripes; and by the characteristic abdominal markings. The apparent first abdominal segment is dark anteriorly, the lower border often edged with a narrow black band; the apparent second segment is edged anteriorly with a narrow black band and a complete or incomplete median stripe; the apparent third segment usually has a small anterior median spot or stripe. An examination of the proboscis will always confirm the determination; the large shining bulb, or mentum, is very characteristic, and when the teeth are everted they can be easily seen.

The following key to the species noted above may be useful to those who wish to identify their specimens:

Key to the males of the known Philippine species of the genus Musca.

1. Small or medium-sized species with four thoracic stripes..... 2.
 Medium-sized species with only two thoracic stripes..... 6.
 Large species with four thoracic stripes..... 7.
2. Small species. Thorax greenish gray with four moderately broad, black thoracic stripes tending to unite behind the suture. Abdomen orange with well-marked gray pollinosity; apparent first segment dark brown or nearly so..... *M. conducens* Patton.
 Medium-sized species. Thorax grayish or blackish..... 3.
3. Thorax grayish with four either broad or narrow black stripes. Eyes well separated 4.
 Thorax grayish or greenish, with four narrower stripes. Eyes almost meeting in the middle line..... 5.
 Thorax blackish with four broad black stripes, not easily seen. Abdomen orange without any markings..... *M. ventrosa* Wiedemann.
4. Abdomen light orange; apparent first segment narrowly black anteriorly; apparent third segment mainly orange..... *M. nebulo* Fabricius.
 Abdomen darker orange; apparent first segment with broader black band; apparent third segment mainly black..... *M. vicina* Macquart.
 Abdomen olive green; apparent first segment black anteriorly, remainder grayish green; apparent second segment grayish green with a median narrow black stripe; apparent third segment with an anterior median black spot..... *M. crassirostris* Stein.

5. Thorax dark gray, inner thoracic stripes very narrow before the suture. Abdomen dark orange; apparent first segment dark; apparent third and fourth segments blackish..... *M. craggi* Patton.
 Thorax greenish gray, inner stripes not markedly narrow in front of the suture. Abdomen bright orange; apparent first segment darker anteriorly; apparent second with a narrow median stripe.
M. planiceps Wiedemann.
6. Thorax gray with two broad black stripes. Abdomen orange; apparent first segment either dark or light brown; apparent third and fourth segments with a median black stripe and admedian and marginal silvery spots. Eyes well separated..... *M. sorbens* Wiedemann.
 Thorax bluish gray with two broad black stripes. Abdomen dark orange; apparent first segment black; other two segments similar to those of *sorbens*. Eyes almost meeting in the middle line.
M. vetustissima Walker.
7. Large species with dark gray thorax and well-marked broad black stripes. Abdomen brown with silvery and black stripes. Squamæ with long black hairs on middle and posterior part of upper surface. Eyes widely separated..... *M. inferior* Stein.
 Large species; thorax gray with four broad black stripes. Abdomen dark orange with dark stripes and silvery spots. Squamæ bare on upper surface. Eyes meeting in middle line..... *M. bakeri* sp. nov.

Key to the females of the known Philippine species of the genus Musca.

1. Small or medium-sized species with four thoracic stripes..... 2.
 Medium-sized species with only two thoracic stripes..... 6.
 Large species with four thoracic stripes..... 7.
2. Small species. Thorax light gray with four comparatively narrow black stripes, well separated. Abdomen dark gray with bands and stripes; apparent first segment black; apparent second segment with a basal black band of varying width..... *M. conducens* Patton.
 Medium-sized species. Thorax grayish or blackish..... 3.
3. Thorax dark gray with four broad black stripes..... 4.
 Thorax lighter gray with four narrower black stripes..... 5.
4. Abdomen dark brown; apparent first segment black or dark brown anteriorly *M. vicina* Macquart.
 Abdomen light orange; apparent first segment also light orange; silvery stripes and spots on remaining segments well marked.
M. nebulo Fabricius.
5. Inner thoracic stripes in front of suture narrowing toward the head. Abdomen bright orange; apparent first segment black; apparent second segment with a broad median black stripe and a broad black basal band.
M. craggi Patton.
 Inner thoracic stripes not markedly narrower, if at all, than the outer. Abdomen light orange with well-marked yellow pollinosity.
M. planiceps Wiedemann.
- Inner thoracic stripes a little narrower than the outer. Abdomen olive green; apparent first segment black anteriorly; apparent second segment with an anterior narrow black band and a narrow median black stripe..... *M. crassirostris* Stein.

6. Thorax gray with two black stripes, separated before the suture. Abdomen blackish gray with black bands and stripes.

M. sorbens Wiedemann.

Thorax bluish gray with two black stripes also separated before the suture. Abdomen bluish gray with black bands and stripes.

M. vetustissima Walker.

7. Large species with dark gray thorax and well-marked black stripes.

Abdomen brown with silvery and black stripes and black bands.

Squamæ hairy above as in male..... *M. inferior* Stein.

Large species with dark gray thorax and black stripes. Abdomen dark gray with stripes and bands. Squamæ bare..... *M. bakeri* sp. nov.

I have not been able to recognize the species *Musca favillacea* Walker and there is no type in the British Museum.

In concluding these notes I wish to take the opportunity of thanking Professor Bezzi for allowing me to study this very interesting collection of species of *Musca*. I will be glad to examine any further specimens of species of this genus from these Islands, and any notes relating to the habits of these species will be welcome.

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A NEW ORIENTAL SPECIES OF THE GENUS MUSCA
WITH A NOTE ON THE OCCURRENCE OF MUSCA DASYOPS STEIN IN
CHINA AND A REVISED LIST OF THE ORIENTAL SPECIES OF
THE GENUS MUSCA LINNÆUS

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In a large collection of Muscidæ from Java, Amboina, Borneo, and Honolulu recently sent me by Mr. J. F. Illingworth there are four specimens of a species of *Musca* which I believe is new to science. It is described below under the name *Musca illingworthi*, in honor of Mr. Illingworth, who has done much to advance our knowledge of the higher Diptera of the Oriental and Australasian Regions.

***Musca illingworthi* sp. nov.**

Male.—Average length of two specimens, 7.5 millimeters. Eyes bare and nearly meeting in the middle line; frons a narrow black line, pinched in the middle; parafrontals, parafacials, and cheeks silvery; third antennal segment mouse gray; palps black and proboscis normal.

Thorax, ground color grayish blue with four broad black stripes meeting at the anterior end of the thorax and not interrupted at the suture; scutellum black in the middle and bluish gray at the sides. Two well-marked presutural dorso-central bristles, presutural acrostical bristles wanting. Abdomen with apparent first segment dark brown or black anteriorly and at the sides, and a rather diffuse dark brown patch in the middle line, which in one specimen forms a partial dark basal band; the anterolateral and ventral sides of the tergite dark orange; apparent second segment with a broad median black stripe widening out anteriorly, and in the darker specimen fusing with the dark patch on the postero-median area of the first tergite; in addition, there is a broad silvery stripe on each side of it, and a large silvery spot at the extreme margin of the tergite; the intervening space is dark orange. The apparent third and fourth segments are similar to the second, the ad-median brown stripes tending to form a narrow dark posterior

band on segment three, which is well marked on the ventral side of the tergite. Sternites dark orange. Wings with four small bristles on the radial root vein, but as they are not in very good preservation it is not possible to be sure of the number; as some of them have certainly fallen off; vein R_{4+5} with small bristles on its ventral side, extending well beyond the radiomedial cross vein. Legs black. Squamæ yellowish.

Female.—Average length of two specimens, 7 millimeters. Frons comparatively narrow, about half the width of the eye, and narrowest at the vertex, the orbital margins converging toward it. Frontal stripe about one-third the width of eye, sides slightly convex. Parafrontals gray, each about one-third the width of the frontal stripe and with a single row of small bristles; parafacials and cheeks silvery gray, edges of epistomum black. Antennæ, palps, and proboscis similar to those of male.

Thorax very similar to that of the male, presutural portion of outer stripes broad and more convex externally. Scutellum grayer at the sides than in the male.

Abdomen with apparent first segment similar to that of the male, but, if anything, the basal black band broader; apparent second segment with a narrower median dark brown stripe, the stripes adjacent to it and the marginal spots yellower, the admedian brown stripes broader, more triangular in shape and extending along the lower border, forming a posterior band interrupted a little in the middle. Apparent third and fourth segments similar, the admedian brown stripes narrower and the basal band on segment three more complete. Sternites as in the male. Legs and wing similar to those of the male.

The four specimens were collected at Buitenzorg, Java, and the types will eventually be returned to Mr. Illingworth, Honolulu, the cotypes remaining in my collection for further study.

I believe this is the species described by Stein,¹ without a name, from Samarang and Batavia. He refers to it again² under the name *Musca lusoria* Wiedemann, noting that it has small bristles all along the ventral side of vein R_{4+5} as in the true *lusoria*. But, as Villeneuve has already pointed out, this is not a character peculiar to *lusoria* but is common to many of the species of this group. Stein's description agrees very

¹ Neue Javanische Anthomyiden, Tijd. voor Entomol. 52 (1909).

² Neue Africanische Anthomyiden, Ann. Hist. Nat. Mus. Nat. Hung. 11 (1913).

well with this species I have before me, especially in the character of the short, wide abdomen, particularly of the female.

Musca illingworthi belongs to my Group II of the Genus *Musca* and, excluding the strictly Indian species, I know only two other Oriental species with which it may be confused; namely, *Musca bakeri* Patton,³ from the Philippines, and *Musca hervei* Villeneuve, from southern China. It can be distinguished from the former by noting the following characters: In the male of *bakeri* the apparent first abdominal segment is either entirely black or there is a narrow posterior brown band; in *illingworthi* the segment is never—at least in the two specimens—entirely black, and the median posterior dark patch is more extensive, forming a band. The second segment in *bakeri* is lighter brown, the marginal silvery spot much smaller and the admedian area not nearly so dark; in *illingworthi* the segment is darker and the admedian brown stripe is pronounced and very dark. These differences are noticeable in the two other segments. The sternites of *bakeri* are black or dark brown, while in *illingworthi* they are light brown. The females are easily distinguished. The female of *bakeri* is a grayish fly, the abdomen in particular having a grayish white checkered appearance; the female *illingworthi*, on the other hand, is similar to the male, and the abdomen is dark brown.

In the British Museum collection I found several males of *Musca bakeri* from Singapore, and a male and two females from Kajoe Taman, Sumatra, showing that this species may quite well be found in the same localities as *Musca illingworthi*. I hope later to have an opportunity of examining the species referred to by Stein; these specimens are, I understand, now in Amsterdam.

Musca illingworthi can be distinguished at once from *Musca hervei* by noting that in the latter the small bristles on the ventral side of vein R_{4+5} are strictly limited to the basal portion of the vein and do not reach or extend beyond the radio-medial cross vein. Further, the sternites and the ventral edges of the tergites in *hervei* are black, giving the appearance of a dark line inclosed in brackets.

In addition to *Musca illingworthi*, the collection contains a long series of both sexes of *Musca inferior* Stein, a very characteristic bloodsucking species belonging to my Group III; both sexes have long dark hairs on the upper surfaces of the squamæ.

³ Antea 316.

There are also one female of *Musca senior-whitei* Patton, recently described from India (this is the first specimen I have seen from Buitenzorg, Java); one rather greasy male of what may be *Musca terræ reginae* Johnstone and Bancroft and a male of *Musca nebulo* Fabricius, both from Guadalcanar Island, Solomon Islands; and several specimens of *Musca vicina* from Java, Amboina, and Honolulu.

NOTE ON THE OCCURRENCE OF *MUSCA DASYOPS* STEIN IN CHINA

Recently during my visit to Prof. M. Bezzi at Turin, he very kindly gave me for description a male and a female of a species of *Musca* sent him by Professor Howard, from Canton, China. On comparing the female with the type and cotype of *Musca dasyops* Stein from Kilamandjaro, East Africa, recently sent to me by Doctor Kertesz for study, I find this Chinese species is identical with it. As Stein never saw the male, I here describe it as well as the female.

Musca dasyops Stein.

Male.—Length, 5.5 millimeters. Eyes densely hairy and almost meeting in the middle line; parafacials silvery; cheeks black. Third antennal segment mouse gray, arista black; palpi black and proboscis normal.

Thorax dark gray, and in some lights appearing almost black; but this specimen is not in good preservation, the thorax being greasy. It is very probable the markings are similar to those of the female (see below). The presutural dorsocentral bristles are poorly developed, especially the one just in front of the suture; presutural acrostical bristles are wanting. The scutellum is dark gray in the center and silvery at the sides.

Abdomen with apparent first segment dark brown; second segment with a broad dark median stripe, and broad anterior and posterior dark brown basal bands, which join each other at about the middle of the sides of the tergite, forming dark brown admedian stripes; the areas between the median stripe and these (the lateral ones) are silvery and appear as white spots; the margins of the tergite are silvery. The third segment is similarly marked, as is also the fourth; the ventral sides of the tergites are lighter brown, with silvery patches. Legs light brown. Wings and venation normal; squamæ brownish and halteres yellowish.

Female.—Length, 6 millimeters. Eyes minutely but thickly pubescent. Frons wide, almost equal to the width of the eye; frontal stripe black; parafrontals black, and equal to about half the width of the frontal stripe; parafrontal bristles long and consisting of three rows, forming a closely set group at vertex, as noted by Stein. Parafacials silvery; cheeks black. Third antennal segment dark brown; palpi black.

Thorax dark with two broad black stripes slightly divided before the suture; a well-marked silvery median stripe before the suture; humerus silvery.

Abdomen similar to that of male, except that the admedian stripes on the second segment are not complete and the silvery spots form a silvery median band. Wings, legs, squamæ, and halteres as in male.

Were it not that I have been able to compare the two Chinese specimens with the type and cotype of *Musca dasyops*, I should have hesitated to regard them as conspecific, especially when it is remembered that they are found in two widely separated areas. I have not seen *M. dasyops* from any part of India. The two specimens noted by Stein came from Kilamandjaro, East Africa, and Professor Bezzi gave me a female collected by Allaud and Jeannel in the forest region of Mount Kenya, at an altitude of 2,400 meters. Villeneuve has evidently seen fifty specimens including two males collected by these observers. The species is oviparous. I hope collectors in China and neighboring parts will look for this interesting species and observe its feeding and breeding habits.

REVISED LIST OF THE ORIENTAL SPECIES OF THE GENUS *MUSCA* LINNÆUS

In the following list all the types of the species marked with an asterisk have been examined by me, and the synonyms with a query before them are doubtful.

Musca domestica Linnæus.

- Musca calleva* Walker.*
- Musca antiquissima* Walker.*
- Musca vicaria* Walker.*
- Musca pampasiana* Bigot.*
- Musca minor* Macquart.*
- Musca corvina* Fabricius.
- Musca ludifica* Fabricius.

Musca umbraculata Fabricius.

? *Musca pellucens* Meigen.

? *Musca chiiensis* Macquart.

? *Musca lateralis* Macquart.

? *Musca aurifacies* R-D.

? *Musca riparia* R-D.

? *Musca campestris* R-D.

? *Musca stomoxidea* R-D.

? *Musca campicola* R-D.

? *Musca vagatoria* R-D.

? *Musca hottentota* R-D.

? *Musca vicina* R-D.

? *Musca campicola* R-D.

? *Musca rivulans* R-D.

Musca frontalis R-D.

Common in Kashmir and the large seaports of the Oriental Region, and possibly inland.

As would be expected, the common house fly *Musca domestica* Linnæus has been described many times. Wiedemann who studied Fabricius's collection at Kiel states it did not contain a single specimen of *M. domestica*, labeled as such by Fabricius, but that *corvina* Fabricius, *ludifica* Fabricius, and *umbraculata* Fabricius are nothing more than *domestica* Linnæus. As Wiedemann must have examined the types of these species and notes that the specimen of *corvina* and *umbraculata* labeled by Fabricius at Copenhagen are *domestica*, we must accept these determinations as final, and remove the names *corvina* and *ludifica* from the synonymy of *Musca autumnalis* de Geer. The remaining synonyms must be regarded in the nature of mere guesses at the truth; the types, except that of *frontalis*, do not exist and it is quite impossible to determine the species.

Musca vicina Macquart.*

Musca flavinervis Thomson.*

Musca flavifacies Bigot.*

* *Musca flavipennis* Bigot.*

Musca atrifrons Bigot.*

? *Musca biseta* Hough.

? *Musca divaricata* Awati.

? *Musca analis* Macquart.

? *Musca sanctae-helenae* Macquart.

? *Musca basilaris* Macquart.

? *Musca frontalis* Macquart (nec Rondani).

? *Musca senegalensis* Macquart.

? *Musca consanguinea* Rondani.

? *Musca divaricata* Awati.

One of the widely distributed house flies of the Oriental Region.

As already pointed out, I have examined the type of *Musca vicina* Macquart and find it is the species which is very like the typical *domestica*, but differing in that the male has a much narrower front—about half the width of the male of *domestica*. I have also examined the types of *flavinervis*, *flavifacies*, *flavipennis*, and *atrifrons*, and note that they are this species. I hope soon to have an opportunity of examining the type of *biseia* Hough. The remaining synonyms are given with a mark of interrogation before them, as I am unable to determine them from the descriptions of their authors. Stein has several times referred to this species of *Musca*, regarding it as a narrow-fronted *domestica*.

***Musca nebulo* Fabricius.**

Musca determinata Walker (nec Patton).*

? *Musca multispina* Awati.

The other common house fly of the Oriental Region.

Unfortunately, the type of this important fly has shared the fate of the rest of the collection of Diptera belonging to Fabricius at Kiel; but, as Wiedemann examined this type when it was still intact and redescribed it very fully, I have no hesitation in accepting as final Major Austen's determination given me many years ago. Wiedemann says: "Hinterleib gelblich durchscheinend, in gewisser Richtung weisslich fast gewürfelt, mit schwarzer, den vierten Abschnitt nicht erreichender Strieme," which agrees exactly with the characters of the abdomen of this species.

Musca yerburyi* Patton.

Musca incerta Patton (nec Walker).*

Common in southern India, Ceylon, and Burma.

Shortly after describing this species under the name *incerta*, I found that the name was preoccupied by *Musca incerta* Walker, so I here take the opportunity of changing the name to *yerburyi* in honor of Colonel Yerbury who has done so much to advance our knowledge of the Oriental and, particularly, the Cingalese species of the genus *Musca*. I have not seen this species in any of the collections I examined in the continental museums. So far, it is now known only from India.

Musca sorbens Wiedemann.*

- Musca humilis* Wiedemann.*
- Musca latifrons* Wiedemann.*
- Musca mediana* Wiedemann.*
- Musca spectanda* Wiedemann.*
- Musca angustifrons* Thomson.*
- Musca bivittata* Thomson.*
- Musca sordissima* Walker.*
- Musca eutentiata* Bigot.*
- Musca scapularis* Rondani.
- Musca conducens* Patton (nec Walker).*
- Musca praecox* Patton (nec Walker).*
- ? *Musca promisca* Awati.

The well-known and widely distributed, two-striped, gray, tropical house and camp fly.

It is interesting to note that the well-known and common *Musca humilis* was described no less than five times by such a careful worker as Wiedemann; *sorbens* is now the oldest name. *Musca sorbens*, No. 58, a female, came from Sierra Leone; *M. humilis*, No. 59, a male, came from India; *M. spectanda*, No. 61, a male, came from Sierra Leone; *M. latifrons*, No. 16,⁴ a female, came from Macao; and *M. mediana*, No. 18 in the Appendix, a male, came from China.

Wiedemann says the specimens of *mediana* from which he wrote his description are in Trentepohl's and his collections. The former, at Copenhagen, is however not *sorbens* but the species long known to me as *Musca convexifrons* Thomson, and which I now know is *Musca xanthomelas* Wiedemann. The specimen in von Winthem's collection at Vienna, which I now have before me, has a small piece of red paper indicating that Wiedemann meant it to be his type, and so I interpret it; it is a typical specimen of the female *sorbens*.

Most dipterists who have attempted to determine *Musca spectanda* from Wiedemann's description alone have gone wide of the mark; and I must admit that, though I have read the description of *spectanda* many times, I never recognized in it *humilis*, or, as it should now be called, *sorbens*. This is a very good example of the great importance of examining all the types of these older authors. I have already corrected a mistake made in interpreting *Musca conducens* Walker and *M. praecox* Walker as *sorbens*; both are, however, quite another species (see below).

⁴ Appendix to Volume II, Aussereuropäische zweiflügelige Insecten.

Musca vetustissima* Walker.*Musca pumila* Patton (nec Macquart).*Musca minor* Patton (nec Macquart).*Musca humilis* Stein et auctores (nec Wiedemann).*Musca corvina* Froggatt (nec Fabricius).*Musca niveisquama* Thomson.*

A common Oriental species.

As I have not been able to find a type of *Musca pumila* Macquart, and cannot be certain of the identity of this species from Macquart's meager description, I propose dropping this name. I am, however, certain of the identity of *vetustissima* Walker and, therefore, propose using this name in the future. *Musca niveisquama*, the type of which I have seen at Copenhagen, is also this species. Both Stein and Austen evidently had what were considered to be cotypes sent them, but which are not conspecific with the type which is clearly labeled so by Thomson.

***Musca tempestiva* Fallen.**? *Musca curpea* Macquart.? *Musca nana* Meigen.

Found in Kashmir.

I have only seen this species from Kashmir. It can very easily be confused with *Musca conducens*.

***Musca vitripennis* Meigen.**? *Musca osiris* Wiedemann.? *Musca sugillatrix* R-D.? *Musca phasiaformis* Meigen.

Found in Kashmir.

I hope to see Wiedemann's type of *osiris* later, and only provisionally give it as a synonym for *vitripennis*.

Musca ventrosa* Wiedemann.*Musca xanthomela* Walker.**Musca angustifrons* Thomson.*Musca pungoana* Karsch.*? *Musca kasauliensis* Awati.

Widely distributed in the Oriental Region.

Musca craggi* Patton.

Common in southern India, Ceylon, and the Philippine Islands.

This rather small species is easily recognized by its bluish thorax, and the narrow presutural portion of the inner stripes.

Musca villeneuvi Patton.*

From southern India.

A smallish species with only two thoracic stripes; the puparium is white.

Musca lucens Villeneuve.*

Recorded from Kandy, Ceylon.

This small species was recently described by Villeneuve from Kandy, Ceylon. I found one male collected by Colonel Yerbury at Trincomali (January 13, 1892), and two females, one from Haragam (June 1, 1892) and the other from Trincomali, Ceylon, (July 20, 1890) in his collection at the British Museum. As Villeneuve has only described the male, I give a short description of the female, as follows:

Female.—Frons almost the width of eye; frontal stripe about one-third the width of eye; parafrontal bristles in two rows; parafacials and cheeks silvery; vertex steel blue. Antennæ and palps dark gray. Thorax bluish white with two broad black stripes; in one specimen the stripes are a little divided before the suture, giving the appearance of four stripes; sides of thorax grayish white. Scutellum light brown in the middle and bluish gray at the sides. Abdomen with apparent first segment light brown; second segment similar, with some bluish pollinosity; third segment similar; the fourth is brownish in the center and silvery at the sides. Legs light brown.

The male of this species can quite easily be confused with the male of *Musca conducens*; however, it has only two thoracic stripes, while *conducens* has four, which only tend to unite. The females are quite distinct.

Musca conducens Walker.*

Musca praecox Walker.*

Musca humilis Patton (nec Wiedemann).

Pristirhynchomyia lineata Brunetti.

A widely distributed Oriental species.

This small species is of great interest as it possesses well-developed prestomal teeth, which are capable of scratching off a small clot or scab. Though I have not seen the type of *Pristirhynchomyia lineata* Brunetti, which is in the Indian Museum, I have specimens, labeled by Mr. Brunetti. The female can quite easily be mistaken for the female of *tempestiva*.

Musca xanthomelas* Wiedemann.*Musca albomaculata* Villeneuve, Patton (nec Macquart).**Musca dorsomaculata* Villeneuve, Patton (nec Macquart).**Musca convexifrons* Bezzi, Patton (nec Thomson).

A common Indian species.

This species has long been confused with *convexifrons* Thomson, and recently with *albomaculata* Macquart and *dorsomaculata* Macquart. The type of *xanthomelas*, a female in Westermann's collection at Copenhagen, though in bad preservation, is a typical specimen of this Indian species; it was collected in Java from where it has not since been recorded; it has a white puparium.

Musca albina* Wiedemann.*Musca speculifera* Bezzi.**Musca beckeri* Schnable.

Found in Ceylon and Baluchistan, in the Oriental Region.

Colonel Yerbury's collection contains one female *albina* from Trincomali (October 1, 1890) and a male from Mahagasy (November 30, 1890). The male of this interesting species has not been described, but Professor Bezzi tells me he has recently prepared a description of it as well as of the male of *lucidula* Loew (which closely simulates it) from material from Cairo, where both species are not uncommon. He is erecting a new subgenus for *albina*, in both sexes of which sternopleural bristles are wanting. Except the type, which is a female, from India, I have seen only one other specimen from Baluchistan in the Indian Museum collection, which I now have for study. Colonel Yerbury is to be congratulated on securing these specimens, especially the male, from Ceylon. I hope collectors in the Oriental Region will look for this interesting species. It is a very whitish fly, the female particularly so, with a very broad frons and a narrow black frontal stripe. The thorax of the male is glossy black, the humeri are white; the abdomen is light orange with spots and stripes, as in *lucidula*.

Musca gibsoni* Patton and Cragg.*? Musca latiparafrons* Awati.

Common in many parts of India and Ceylon.

I have not seen this species from anywhere outside the Indian area; in the male the eyes are minutely pubescent. The types are in the Indian Museum, but I have many cotypes in my collection.

Musca pattoni Austen.*

? *Musca spinosa* Awati.

I have not seen this species from outside the Indian area.

Musca spinohumera Awati.

I am not sure of the identity of this species. Mr. Senior-White has tried, on more than one occasion, to get the types of Mr. Awati's species, but has so far failed. It is a great pity these have not been deposited in the Indian Museum.

Musca prashadi Patton.*

From Kashmir.

Musca bezzii Patton and Cragg.*

? *Musca pilosa* Awati.

Widely distributed in India.

I have not seen this species from any other part of the Oriental Region. It appears to be strictly Indian, and is mainly a hill species. The types are in the Indian Museum, the cotypes in my collection.

Musca bakeri Patton.*

From the Philippine Islands.

Musca hervei Villeneuve.*

From southern China.

Musca illingworthi Patton.*

From Java and neighboring parts.

Musca convexifrons Thomson.*

From southern China.

This species is common in Australia.

Musca dasyops Stein.*

From southern China.

Musca senior-whitei Patton.*

Common in Bengal and Bezwada, India.

I have noted above a single female in Mr. Illingworth's collection.

Musca inferior Stein.

Philaematomyia gurneyi Patton and Cragg.*

Widely distributed in the Oriental Region.

The types of *P. gurneyi* are in the Indian Museum.

Musca planiceps* Wiedemann.*Musca cingalaisina* Bigot.**Musca pollinosa* Stein.*Philaematomyia indica* Awati.

Widely distributed in the Oriental Region.

The type of *Musca planiceps* from Java is in Westermann's collection at Copenhagen. Though I have not seen Stein's types of *Musca pollinosa* I have no doubt that it is this species.

Musca crassirostris* Stein.Musca modesta* de Meijere.*Musca insignis* Austen.*

Widely distributed in the Oriental Region.

I quite expected to find this species either in Westermann's collection at Copenhagen or in that of von Winthem at Vienna, but as I was unable to see the latter when at Vienna, Doctor Zerny has kindly sent me the types of Wiedemann's species of *Musca*. I find this species is represented by one female, labeled *inconstans* in Wiedemann's handwriting; on looking for this name in Volume 2 of his celebrated work, I find the name without an index number and, unfortunately, it does not appear to have been described; so the name cannot be used. The specimen in question, a female, is from India. With Professor Bezzi I came to the conclusion that *Musca modesta* is this species, and Professor de Meijere tells me this is the case. I hope later to see the types of this species as well as those of *crassirostris*.

From the above list it will be seen that I have examined fifty-three types. I hope in due course to publish a paper on the Oriental species in collaboration with Mr. Senior-White, in which all the above species will be fully described and illustrated, and a key given for their identification. I will be glad to have any material from southern China, Formosa, and neighboring parts, so as to make this paper as nearly complete as possible. Larvæ of any species with adults bred from them will be most welcome.

In conclusion, I wish to take this opportunity of thanking Mr. Illingworth for sending me this valuable collection for study.

THE COMPOSITION OF CASHEW-NUT OIL

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and

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INTRODUCTION

Cashew-nut oil, commonly called kasui in Manila, is obtained from the seed of *Anacardium occidentale*, a small tree with a trunk that is usually small and crooked. This species occurs in the East and West Indies and was introduced into the Philippines from America at an early date. It is widely distributed in the Philippines and is cultivated in towns and on farms and runs wild in old clearings. It has a large, yellow, pear-shaped fruit, with a kidney-shaped seed attached to one end. Both the fruit and the seed are edible, the fruit raw and the kernel raw or roasted. The roasted kernels are used to make a very savory nut candy.

According to Watt¹ two oils are obtained from the seeds of *Anacardium occidentale*.

The pressed kernels yield an oil, the finest quality of which is equal to almond oil; and the shell of the nut yields an acrid fluid, called "cardol" which is efficacious for protecting carved wood, books, etc., against white ants. Cashew-nut oil obtained from the pressed kernels is an edible oil which has a somewhat sweet taste and yellow color. The keeping quality of the oil is very good, as shown by the fact that a sample stored for five months had no rancid taste or odor, and the acid value was only 1.45.

Lewkowitsch² states that the yield of oil from the kernels is 47.2 per cent; but he gives no data concerning the composition of the oil.

¹ Watt, G., *The Commercial Products of India* (1908).

² Lewkowitsch, J., *Oils, Fats, and Waxes* 2 (1915) 404.

SAMPLE

The sample of oil used in this investigation was obtained from cashew-nut seeds which were purchased in the various markets in Manila. Six boys were set to work to separate the kernels from the shells. The seeds were cut in half with a knife and the kernel was taken out of the shell, after which the brown skin surrounding the kernel was removed. The kernels were ground into a meal, placed in a small press, and the oil separated from the oil cake. The oil was then filtered and stored in glass-stoppered bottles.

The analysis³ of the oil cake is given in Table 1.

TABLE 1.—*Analysis of cashew-nut oil cake.*

Constituents.	Per cent.
Oil	16.12
Moisture	2.37
Ash	3.94
Protein	31.67
Nitrogen	5.70
Crude fiber	0.44
Carbohydrates	45.46

CONSTANTS

The more-important constants of cashew-nut oil are given in Table 2.

TABLE 2.—*Constants of cashew-nut oil.*

Specific gravity at $\frac{26.6^{\circ}}{4^{\circ}}$	0.9105
Refractive index at 30° C.	1.4665
Iodine value (Hübl)	85.20
Saponification value	187.00
Acid value	1.45
Unsaponifiable matter (per cent)	^a 1.47

^a Iodine value, 94.55^b

In investigating the composition of cashew-nut oil the saturated and unsaturated acids, which are present as glycerides in the oil, were separated by the lead-salt-ether method.⁴ The unsaturated acids were determined by means of the bromo-derivative method.⁵ The saturated acids were converted into their

³ Analysis made by Miss C. M. Spooner, of the Bureau of Science, Manila.

⁴ Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 556.

⁵ Ibid (1921) 585.

methyl esters,⁶ which were fractionally distilled. The composition of the saturated acids was estimated by calculating the data obtained from the methyl esters.

SEPARATION OF SATURATED AND UNSATURATED ACIDS

The lead-salt-ether method does not give complete separation of saturated and unsaturated acids, since the saturated acids are always contaminated by a small quantity of unsaturated acids, as shown by the iodine value of the saturated acids. The unsaturated acids are also likely to be contaminated with a small quantity of saturated acids, but this error can usually be reduced to an unappreciable amount by not washing very thoroughly with ether the lead salts of the saturated acids.⁷

In separating the saturated and unsaturated acids by the lead-salt-ether method the unsaponifiable matter originally present in the oil goes with the unsaturated acids.⁸ The percentage of impure unsaturated acids, as determined, should therefore be corrected, not only for the small amount of unsaturated acids present in the saturated acids, but also for the unsaponifiable matter which they contain.

The results of separating the saturated and unsaturated acids of cashew-nut oil by the lead-salt-ether method are given in Table 3.

TABLE 3.—*Separation of saturated and unsaturated acids of cashew-nut oil by the lead-salt-ether method.*

	Per cent.
Impure saturated acids (determined)	^a 23.10
Unsaturated acids and unsaponifiable matter. (determined)	^b 72.31
Total	95.41

^a Iodine value (Hübl) 26.79.

^b Iodine value (Hübl) 94.18.

⁶ Jamieson, G. S., and Baughman, W. F., *Journ. Am. Chem. Soc.* 42 (1920) 1200.

⁷ Baughman, W. F., Brauns, D., and Jamieson, G. S., *Journ. Am. Chem. Soc.* 42 (1920) 2398.

⁸ Lewkowitsch, J., *Chemical Technology and Analysis of Oils, Fats, and Waxes* 1 (1921) 584; Baughman, W. F., and Jamieson, G. S., *Journ. Am. Chem. Soc.* 43 (1921) 2679.

TABLE 3.—*Separation of saturated and unsaturated acids of cashew-nut oil by the lead-salt-ether method—Continued.*

Unsaponifiable matter (calculated) in the total determined percentage of saturated acids, unsaturated acids, and unsaponifiable matter (95.41)	1.94
Pure unsaturated acids corrected for unsaponifiable matter	70.37
Unsaturated acids present in the impure saturated acids	6.57
Pure saturated acids corrected for unsaturated acids (calculated)	16.53
Pure unsaturated acids corrected for unsaponifiable matter and for the unsaturated acids present in the saturated acids	76.94

The percentage of unsaponifiable matter (1.47, Table 2) originally present in the oil is equivalent to 1.94 per cent in the total percentage (95.41, Table 3) of the impure saturated acids, unsaturated acids, and unsaponifiable matter:

$$\frac{(72.31 + 23.10) \times 1.47}{72.31} = 1.94.$$

The percentage of pure unsaturated acids corrected for unsaponifiable matter is, therefore, 70.37:

$$95.41 - (23.10 + 1.94) = 70.37.$$

The impure saturated acids separated by the lead-salt-ether method had an iodine value of 26.79. The unsaturated acids present as contamination in the impure saturated acids was 6.57 per cent:

$$\frac{23.10 \times 26.79}{94.18} = 6.57.$$

The percentage of pure saturated acids was $23.10 - 6.57$, or 16.53. The percentage of the total pure unsaturated acids corrected for unsaponifiable matter and for the unsaturated acids (6.57 per cent) which were present as contamination in the impure saturated acids was $70.37 + 6.57$, or 76.94.

UNSATURATED ACIDS

The impure unsaturated acids separated by the lead-salt-ether method were determined by means of the bromo-derivative method, which is used to separate the various unsaturated acids from each other. The sample of unsaturated acids and unsaponifiable matter (1.3172 grams) used for preparing the bromo-derivatives consisted of 0.0353 gram of unsaponifiable matter and 1.2819 grams of pure unsaturated acids. The bro-

mine addition products were prepared by dissolving the unsaturated acids and unsaponifiable matter in ether; the ethereal solution was cooled to a temperature of -10° and bromine added slowly, after which the solution was allowed to stand about three hours at -10° . No crystals of linolenic hexabromide, which is insoluble in ether, were obtained. This indicated that cashew-nut oil contained no linolenic glyceride. The ethereal solution was then treated with 10 per cent sodium thiosulphate solution to remove the excess of bromine. This treatment was repeated to remove the last traces of bromine, after which the separated ethereal solution was dehydrated with anhydrous sodium sulphate, filtered, and distilled to eliminate the ether. The residue was then treated with petroleum ether (boiling point, 35° to 55°) and heated (reflux) for about a half hour. The petroleum ether solution was then cooled and allowed to stand several hours. No crystals of linolic tetrabromide were obtained. The solution was concentrated by distilling to a volume of about 200 cubic centimeters, cooled, and allowed to stand several hours but, still, the tetrabromide did not crystallize. This indicated that, if the oil contained linolic glyceride, the percentage was probably small. The petroleum ether solution was concentrated to a volume of about 100 cubic centimeters, transferred to a small distilling flask and the petroleum ether eliminated by distilling under diminished pressure. The impure residue (2.0841 grams) consisted of brominated unsaturated acids and brominated unsaponifiable matter. The bromine content (36.70 per cent) of the impure residue was determined by boiling 0.5368 gram with about 0.5 gram of solid silver nitrate and 30 cubic centimeters of pure concentrated nitric acid. The precipitated silver bromide (0.4630 gram) was then collected on a Gooch filter.

The iodine value of the unsaponifiable matter in the oil was 94.55. This is equivalent to a bromine value of 59.56 and corresponds to 0.0086 gram of bromine in the unsaponifiable matter contained in the sample of impure residue used for the bromide analysis. The pure brominated unsaturated acids (2.0282 grams) in the total impure residue (2.0841 grams) obtained from the preparation of bromo-derivatives had a calculated bromine content of 36.06 per cent. The bromine content of oleic dibromide is 36.18 per cent. Since the calculated percentage of bromine in the brominated unsaturated acids was 36.06, the unsaturated acids consist of oleic acid only.

The percentage of unsaturated acids, separated by the lead-salt-ether method, corrected for unsaponifiable matter and for the amount of unsaturated acids present in the saturated acids, was 76.94 (Table 3), which is equivalent to 80.40 per cent of oleic glyceride originally present in the oil. The data obtained by the analysis of the bromo-derivatives and a summary of the calculated results are given in Table 4.

TABLE 4.—*Analysis of unsaturated acids (bromo-derivative method).*

	Grams.	Per cent.
Sample of unsaturated acids containing unsaponifiable matter	1.3172	-----
Unsaponifiable matter in the mixture of unsaturated acids and unsaponifiable matter	0.0353	2.68
Pure unsaturated acids in mixture of unsaturated acids and unsaponifiable matter	1.2819	-----
Linolenic hexabromide insoluble in ether	-----	-----
Linolic tetrabromide insoluble in petroleum ether	-----	-----
Impure residue (brominated unsaturated acids and brominated unsaponifiable matter) determined	2.0841	-----
Brominated unsaponifiable matter in impure residue (calculated)	0.0559	2.68
Unsaponifiable matter in sample of impure residue (0.5368 gram) used for bromide analysis	0.0144	-----
Bromine in the unsaponifiable matter (iodine No. 94.55) contained in sample of residue used for bromide analysis	0.0086	-----
Bromine in impure residue analyzed (silver bromide, 0.4630 gram)	0.1970	36.70
Bromine in pure brominated unsaturated acids contained in sample of impure residue analyzed	0.1884	-----
Bromine in pure brominated unsaturated acids contained in total impure residue	0.7314	-----
Pure brominated unsaturated acids (bromine content, 36.06 per cent) in total impure residue	2.0282	-----
Oleic acid equivalent to dibromide	1.2940	-----
Unsaturated acids separated by lead-salt-ether method (corrected)	-----	76.94
Oleic glyceride in oil	-----	80.40

The calculated iodine value of the mixture of unsaturated acids and unsaponifiable matter is 90.19, which agrees fairly well with the determined value, 94.18 (Table 3).

SATURATED ACIDS

The impure saturated acids were converted into their methyl esters by dissolving the acids in methyl alcohol and saturating the solution with dry hydrogen chloride which was prepared by treating fused ammonium chloride with sulphuric acid and passing the gas through sulphuric acid. The mixture was then heated on a water bath (reflux) for fifteen hours, after which it was treated with water and the ester layer separated. The esters were dissolved in ether and the ethereal solution was washed with sodium carbonate solution and afterwards with water. The ethereal solution was then dehydrated with anhydrous sodium sulphate, filtered, and the ether removed by distilling. The impure esters, which were yellow, were distilled under diminished pressure. A preliminary distillation at about 15 millimeters pressure was made to obtain the pure colorless esters and eliminate the dark-colored impurities which were formed as by-products in the esterification process. The colorless esters were then redistilled. Data on the distillation of the esters are given in Table 5.

TABLE 5.—*Distillation of the methyl esters of the saturated acids.*

[52.6666 grams of esters distilled; pressure, 15 millimeters.]

Distillation.	Distillate.	Residue.	Temperature.
	g.	g.	°C.
I -----	48.6132	4.0534	211-215
II -----	45.8184	2.7948	212-214

As a result of the first distillation, 52.6666 grams of esters gave 48.6132 grams of distillate and 4.0534 grams of brown residue. The temperature varied from about 211° to 215°, and the pressure was about 15 millimeters. The colorless distillate was then redistilled, yielding 45.8184 grams of a second distillate and 2.7948 grams of second residue which had a light yellow color. During the second distillation the esters distilled over at a temperature of about 212° to 214°. Since at the beginning of the distillation the esters were colorless and the residue which remained after the distillation was light yellow, it would seem that the esters were partially decomposed during the distillation. At a pressure of 15 millimeters methyl oleate distills at 212° and methyl stearate at 214°. The results ob-

tained indicate that the pure esters consist almost entirely of a mixture of the methyl esters of oleic and stearic acids and that the saturated acids from which the esters were obtained consist of stearic acid only.

The percentage of saturated acids, separated by the lead-salt-ether method, corrected for the unsaturated acids which they contained, was 16.53 (Table 3) which is equivalent to 17.27 per cent of stearic glyceride originally present in the oil.

The residues obtained in distilling the methyl esters were not taken into account in calculating the composition of the saturated acids. In distilling the esters a slight decomposition appeared to occur, and it would seem that data obtained by analyzing the impure residues would not represent exactly the properties of the pure esters. Possibly the residues contained other esters in addition to those recorded; but, considering the temperatures and the manner in which the esters distilled, this would seem to be unlikely.

SUMMARY

Cashew-nut oil is an edible oil which has good keeping qualities and the following composition:

Constituents.	Per cent.
Oleic glyceride	80.4
Stearic glyceride	17.3
Unsaponifiable matter	1.5
Total	99.2

We wish to express our thanks and appreciation to Mr. Arthur F. Fischer, director of the Philippine Bureau of Forestry, for the material used in this investigation and the assistance he has kindly given.

THE JASSOIDEA RELATED TO THE STENOCOTIDÆ WITH SPECIAL REFERENCE TO MALAYAN SPECIES

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FIVE PLATES

In another paper¹ I presented a study of some remarkable, isolated, largely palæotropical jassoid types, which were brought together in the family Stenocotidæ sens. lat. A study of extensive, recently collected Malayan material, Australian material kindly furnished by Mr. F. Muir and Dr. J. F. Illingworth, Japanese material obtained from Prof. S. Matsumura, Indian material from the Zoölogical Survey of India, and Sumatran material from Mr. J. B. Corporaal strengthens the general conclusions reached in that paper, and makes possible the presentation of much more confirmative evidence and a better arrangement of the families and genera involved. This later and more extended study convinces me that the groups formerly proposed are natural ones, and that they are better distinguished and of higher grade than was formerly supposed.

Distant² refers to the above paper, and dismisses the whole matter by saying that he does "not propose to follow" the removal of *Signoretia* from the Tettigoniellidæ.³ He does not explain how a genus having ocelli placed contiguous to the anterior border of the head can possibly be placed in the Tettigoniellidæ as that family is currently characterized—even in the Errhomenellini, in which the ocelli are located farther forward than in normal tettigoniellids, but still on the disk of the vertex and remote from the frontal suture; nor can he mention any true tettigoniellid in which the ocelli are visible in facial view, as they are in all of the insects placed in Stenocotidæ sens. lat. in the paper mentioned.

¹ Philip. Journ. Sci. § D 10 (1915) 189-200.

² Fauna Brit. India, Rhynch. 7 (1918) 12.

³ Doctor Melichar, in litt. January, 1922, says: "*Signoretia* cannot possibly be placed in the Tettigoniellidæ and the separation by you is very correct."

Apparently following the post-Stålian and entirely erroneous disposition of *Signoretia*, Matsumura described as tettigoniellids the genera *Omukia* and *Oniella*; ⁴ but both of these are closely related to *Pythamus* and *Dryadomorpha*, and the position of their ocelli with the accompanying head structure is essentially similar to that in *Signoretia*, *Pythamus*, *Paropia*, and *Dryadomorpha*. *Oniella* shows some remarkable resemblances to *Balbillus*, the position of ocelli with accompanying structures being very similar.

Melichar evidently recognized the relationship of *Pythamus* and *Signoretia* since he placed them together, but in the Tettigoniellidæ.⁵ Distant ⁶ leaves *Signoretia* near *Tettigoniella* but separates *Pythamus* as an unattached genus at the end of the series;⁷ *Chudania*, a nearly related genus, he leaves unattached at the opposite end of the series.⁸ Kirkaldy, in describing *Tortor* and *Dryadomorpha*, recognized that they were out of place in the phrynomorphine series. As previously stated, Stål correctly placed *Signoretia* near *Megophthalmus*.

In his first work above mentioned, Distant also refers to my suggestion of the very close relationship of *Preta* and *Signoretia*, expressing surprise in italics that at the same time differential characters should be given. Do not subgenera, also, have differential characters? In the present paper a new species of *Preta* is described that brings *Preta* and *Signoretia* still closer together and breaks down one of the conspicuous differences supposed to separate them.

This complex is composed of isolated and peculiar types that find no place in other series of jassoid insects, and yet they present fundamental anatomical similarities which indubitably indicate far closer relationship between them than with other Jassoidea. It is essentially an Old World group, though *Paropulopa* is reported from North America, and an entirely peculiar group (Koebeliidæ) occurs in the American Pacific coast states. It seems probable that a number of other aberrant African and Asian genera, scattered through the phrynomorphine and other series, should be removed to the neighborhood of the Stenocotidæ.

The history of the classification of the jassoid insects is that of most large groups, though no attempt has been made toward

⁴ Annot. Zool. Japon. 8¹ (1912) 44-46.

⁵ Homop. Ceylon (1903) 161.

⁶ Fauna Brit. India, Rhynch. 4 (1908) 232.

⁷ Op. cit. 203.

⁸ Op. cit. 268.

development of a general system adapted to include the immense number of forms now in collections, or toward a general and much-needed revision of the genera of the world. We are still trying to use, to include all of the jassoid insects of the world, the very ancient and artificial system originally proposed for a few species formerly known in Europe. If the ocelli were on the disk of the crown, the insect was a tettigoniellid, if on the margin a jassid, and if on the face a bythoscopid; quite disregarding the fact that the ocelli are on the vertex, morphologically speaking, in all of these groups. The utter impossibility of classifying these insects on an artificial one-character basis is very evident in every work that is published on new and little-known faunæ. There is little wonder that Distant could not place *Chudania* or *Pythamus* in any of the older families! Genera of the closest relationships have been placed in remote parts of the ancient "system," and genera of no fundamental relationship are thrown together. Superficial characters cannot be used for general grouping. General outlines of head and pronotum, head thick or thin, etc., are characters widely variable even within the same genus.

In the Nirvaniidæ, among insects of the closest relationship, strongly similar in color pattern and body form, the ocelli may be on the anterior surface of the crown (sometimes far from the margin), on the border between crown and face, or on the upper surface of the face below the border of the crown. Venation can only be used with many reservations. Many of the cross veins are very variable in position and often may be present or absent in the same species. To separate two genera because one has "four apical cells" and another "five apical cells," when it is well known that the subcostal apical cell is a very uncertain feature, is fruitless unless coördinate diagnostic characters can be found. A tegmen of *Signoretia benguetensis* is figured here (Plate 1, fig. 7) in which one of the usually constant cross veins, that at apex of the first subapical cell, is obsolete, leaving only a stump on one side. In *Pythamus* this cross vein is regularly absent. The normal forking of the main veins is of importance, but one branch of the fork may be distinct or indistinguishable in the same genus or even species, as in some of the Nirvaniidæ. Also, the method of examination has made many generic descriptions misleading. In one of the genera of this group described as having venation obsolete, when the tegmen is mounted on a slide and viewed by strong transmitted light the venation is perfectly distinct. Another,

described as with "appendix absent," shows on a mounted specimen a perfectly distinct but very narrow appendix.

If a specimen of a typical *Tettigoniella* be examined, it will be noted that the frontal suture passes on to the crown and caudad to near the position of the ocelli. Most of the crown is, therefore, merely an inflated and highly specialized "front," in the morphological application of the term. In fact, in *Tettigoniella*, we commonly find the oblique stripes, so characteristic of the front in many jassoid insects, carried far over on to the crown. The actual vertex in true tettigoniellids, therefore, even in many forms with greatly produced heads, is very short, but with the ocelli actually near its fore border, the production pertaining entirely to the front, as is commonly the case in the Cercopidæ—a family that shows many close relationships with the Tettigoniellidæ sens. str. In this case the actual basal margin of the front passes across the crown often nearer its base than its apex. In some groups the morphological vertex itself is produced, carrying forward the ocelli, which may thus even come to lie on the face, but still in the same relation to the morphological "front." It thus results that the use of the word "vertex" as equivalent to "crown of head" is entirely erroneous in many cases. The word "vertex" as it occurs in descriptive literature relating to Tettigoniellidæ, Bythoscopidæ, and some other groups should be replaced by "crown."

In some groups the actual upper margin of front and the anterior margin of true vertex adjoin along the anterior margin of the dorsum of head, and in this case the use of the word "vertex," for the entire disk of the crown within the lateral sutures, is correct. In this case the sutures may be clearly marked or entirely obsolete, but the ocelli will usually be found on the anterior margin or immediately above or below it. If the sutures are clearly marked (as in nearly all of the genera in this group) they may be carinately raised, the carina bounding upper margin of front and anterior margin of vertex, often entirely distinct and separate. In the latter case the upper carina may be the stronger, causing the vertex to overhang and extend beyond the front, as in *Stenocotis*, *Koebelia*, etc.; or quite the reverse may be the case, as in *Euacanthus*, many of the Pythamidæ, and notably in *Balbillus*, but there is every gradation in this character. In the groups under discussion the two carinæ diverge laterally in all of their relative locations described above, the ocelli being commonly placed between them,

within this "ocellar area," which is usually part of the "temple," and commonly remote from the eyes. Rarely are the ocelli above or within the upper carina. The carinae may be replaced by blunt folds, or one or the other may be absent, very rarely both. Genera with these characters have been indiscriminately scattered among Acocephalini, Errhomenellini, Tettigoniellini, Jassaria, Hecalusaria, Cephalelusaria, Phrynomorpharia, and even Eupterygini, without consideration of coördinate characters, with the effect of destroying the homogeneity of all these groups, and rendering their systematic definition and synopsis impractical.

True Acocephalini, however, have scarcely more than the value of a "group" in the Phrynomorphini, since, as in most true Jassidæ sens. str., the basal lateral carinae or sutures of front pass over the anterior margin of crown to near the position of the ocelli. It is also doubtful if the Errhomenellini, including *Errhomenellus*, *Anosterostemma*, *Chiasmus*, *Uzelina*, and *Tylozygus*, should be associated closely with the Tettigoniellini. The Penthimiidæ form an assemblage coördinate with Thaumastoscopidæ and Gyponidæ, very homogeneous in form and many important structural characters. Distant's "Mukaria" is separated far from the Tettigoniellidæ and placed among the true jassids, solely because the ocelli are indistinguishable; but two members of the group as he constitutes it are otherwise typical Penthimiidæ and the third is apparently unrelated. Most jassoid groups contain some members with ocelli small, weak, or indistinguishable.

If some of these most disturbing and elsewhere unrelated elements, injected into otherwise homogeneous assemblages and reviewed in the present paper, are brought together and their anatomical details compared, their close genetic relationship will be at once recognized, their interrelationships being closer than with other jassoid insects. It is impossible to present more than a temporary arrangement of these in their relations with older families. The groups here termed families and subfamilies may not be of equivalent grades, but the segregation of them is certainly justified, and still further division of the old family Jassidæ is much to be desired in order to make possible the classification of thousands of tropical forms. It is believed that in the future system of the jassoid insects many families will have to be recognized, and that some of the present subfamilies will then appear as well-founded families. In the meantime rapid additions to material in these little-known groups

is greatly increasing our knowledge of them and making clear their affinities.

Any arrangement based upon the position of the ocelli, used as quite apart from the structural modifications and accompanying sculptural features of the cephalic sclerites that bring about the apparently different positions of the ocelli, can only lead to utter confusion when an attempt is made to arrange the vast tropical faunæ by this ancient and impossible "system." If, instead, we use the fundamental structure of the head, we quickly associate what are evidently closely related forms that were formerly scattered through various sections of the old system. Out of the remarkably homogeneous series of species in the Nirvaniidæ, with a remarkable similarity in fundamental anatomy and likeness in bodily form and even in color patterns, some would be placed in Phrynomorpharia, some in Acocephalini, and some in Tettigoniellidæ—and this has actually occurred.

The following tentative synopsis will bring out some of the relationships discussed above. It does not presume to be the presentation of a complete system for the Jassoidea. Some of the most important anatomical features of very many jassoid genera are undescribed and omitted from figures, so that a general system could not be developed without visits to many of the European collections. The new families proposed are even more distinct than Ulopidae and Paropiidae, which have been long recognized as good primary groups. The "Jassidæ" of this synopsis will have to be further divided. Some of the divisions long recognized, like the Eupterygini, have never been diagnostically characterized. The accepted characterization of Eupterygini will certainly as readily admit to it many tropical forms of other groups like *Nirvana* that have no relation to true Eupterygini.

In future studies and especially in reëxamination of previous types a careful comparative study of leg structure seems certain to yield results of great value. The great diversity of structure in the hind tarsi is shown in the accompanying figure (Plate 1, fig. 1). In *Onukia* (Plate 1, fig. 1, a) and *Pythamus* (Plate 1, fig. 1, b), of the Pythamidæ, the third joint is inserted in second, and second in first, far before the apex, and the length of the first joint is as great as, or greater than, the following two together, the first and second joints being crowned with groups of stout spines or teeth. In both cases there are no lateral spines on the first joint except at the insertion of the succeeding joint. In *Stenometopius* (Nirvaniidæ-Stenometopii-

næ) (Plate 1, fig. 1, *c*) and *Stenotortor* (Nirvaniidæ-Macroceratogoniinæ) (Plate 1, fig. 1, *e*), the first joint is distinctly shorter than the two succeeding, the terminal crowns of spines being reduced, and the first joint is supplied with numerous lateral spines. In these cases the third and second joints are inserted but little before the apex of the proximal joints, or at the extreme apex as in *Stenometopius*. In *Paropia* (Paropiidæ) the apical crowns of spines are entirely lacking and the second joint is distinctly shorter than the third, as in *Preta* (Signorettiidæ) (Plate 1, fig. 1, *d*). However, it will be impossible to make generalizations as to these characters until the types of all older species in these groups can be reëxamined.

Superfamily JASSOIDEA

*Synopsis of families.*⁹

- a*¹. Upper part of front strongly raised and produced, its posterior portion forming a large part of superior surface of head (crown); the true vertex confined to basal portion of crown, the ocelli thus on posterior disk of crown and usually remote from eyes.
- b*¹. Lateral sutures of front distinctly continued over the obtuse anterior margin of crown to near the position of ocelli (as in the Cercopidæ); antennæ between and near eyes..... Tettigoniellidæ.
- b*². Lateral sutures of front obsolete beyond antennæ or beyond anterior border of crown.
- c*¹. Antennæ not far removed from eyes and near but never above level of eyes; lateral margins of front obsolete beyond scrobes.
- d*¹. Head acute angled between crown and face; face of normal proportions; lateral sutures of front entering and terminating in antennal scrobes, face shallowly concave; body long ovate.
Gyponidæ.
- d*². Head obtusely rounded between the strongly declivous crown and face, strongly overhanging the latter, which is deeply concave; lateral sutures of front passing mesad of antennæ; face very short, far broader than long..... Penthimiidæ.
- c*². Antennæ situated entirely above and far removed from eyes; head anteriorly transversely thin laminate.
- d*¹. Outlined lower portion of front short and broad.
Thaumastoscopidæ.
- d*². Outlined lower portion of front long and narrow..... Ledridæ.
- a*². Upper part of front confined entirely to face, except sometimes for a narrow border.
- b*¹. Vertex entirely superior, occupying nearly all or all of crown, the junction with front occurring on anterior border of crown, the ocelli on or near anterior border of head.

⁹ This synopsis, in the present abbreviated form, uses principally cephalic characters. Many coördinated characters can be drawn from other parts of the body, notably tegmina, wings, and legs.

- c¹. Basal suture of front distinct and entire, centrally at least, approaching more or less closely the anterior margin of vertex; when subobsolete above, its position always marked by a fold or carina; in the latter case, the remaining portion of frontal suture is always directed toward the base of front and not toward ocellus; anterior border of vertex usually marked by a sharp margin or carina.
- d¹. Anterior border of vertex sharply laminately expanded, distinctly overhanging upper part of front; antennæ situated far mesad of eyes; ocelli, when distinguishable, lying between extended margin of vertex and basal margin of front in a transversely triangular (rarely linear) ocellar area and very remote from eyes.
- e¹. Pronotum extended between and cephalad of eyes; vertex very short, transverse, and deeply concave.
- f¹. Tegmina normally veined; genæ narrower than front; front strongly excavate, with high raised margins; clypeus little exerted; ocellar area very broad; hind tibiæ with very few small spines and hairs on apical half; sculpture characterized by a deep thimble pitting..... *Paropiidæ*.
- f². Tegmina with numerous supernumerary veins; genæ wider than front; front convex; clypeus long exerted; ocellar area narrow, bounded beneath by a shallow fold; hind tibiæ with stout spinose teeth, few in number but distributed along entire length; sculpture characterized by coarse striations and wrinkles..... *Stenocotidæ*.
- e². Pronotum not abnormally extended between eyes; vertex not very short and long transverse, the width not more than twice length; ocelli a little nearer to eyes than to median line or indistinguishable.
- f¹. Genæ longer than broad, flat or concave, outwardly emarginate, normally bordering the loræ to the clypeus; scrobes very shallow and lacking strong supra-antennal ledges (as in *Stenocotidæ*); pronotum with very short lateral margins, converging anteriorly, ocelli distinct..... *Koebeliidæ*.
- f². Genæ broader than long, strongly convex, not passing loræ (at level of face), their apical margins roundly curved inward to meet the front above the loræ, leaving outer margin of latter fully exposed in facial view; scrobes very deep, under strongly overhanging and curved supra-antennal ledges; pronotum with very long lateral margins, usually converging posteriorly..... *Ulopidæ*.
- d². Anterior border of vertex sharply marked (head may be laminately extended between eyes) but never with this margin extended beyond and overhanging upper part of front; usually with clearly marked subtriangular ocellar areas at the sides between vertex and front; these areas are commonly occupied by the ocelli, though the latter may occur near by on upper surface of crown, then usually on or outside the carinate or raised lateral margin of vertex; antennæ situated close to anterior line of eyes.

- e*¹. Upper margin of front a little extended beyond margin of vertex and plainly visible in dorsal view at least at sides, the lateral and anterior submarginal carinæ of vertex usually distinct, often very strong.
- f*¹. Pronotum very long, strongly produced and outcurved caudad, largely covering the scutellum; head with eyes broader than pronotum; vertex with a very strong thickened basal transverse ridge; supra-antennal ledge callously thickened and lobed over frontal margin; clypeus truncate or notched apically and little or not exerted; sides of front not sinuate at scrobes; ocelli in marginal areas and visible from above or below..... *Signoretiidæ*.
- f*². Pronotum not produced caudad over the very large scutellum, the hind border truncate or concave; head more or less distinctly narrower than pronotum; vertex without strongly thickened basal ridge; supra-antennal ledge neither strongly callose nor lobed over frontal margin; antennæ between the eyes near middle of their inner margins.
- g*¹. Pronotum short, broad, broadly rounded anteriorly, the head but slightly narrower; vertex very broad, nearly twice as broad as long; width of head greater than length of head and pronotum together; ocelli situated a little within anterior margin of crown, but outside the antero-lateral carina of vertex, and invisible in facial view.
Euacanthidæ.
- g*². Pronotum more or less narrowly rounded anteriorly, the head very distinctly narrower, vertex always much less than twice as broad as long; width of head always much less than length of head and pronotum together; ocelli in or very near lateral areas, and usually visible both in dorsal and facial views..... *Pythamidæ*.
- e*². Upper margin of face not at all extended beyond margin of vertex and not visible in dorsal view, or only little so just in front of eyes; ocelli on anterolateral border of head or just above or below it; loræ very small and narrow; tegmina usually without anteapical cells and venation usually indistinct basally; antennæ usually inserted distinctly above the eyes in facial view, rarely on upper line of or between eyes, in which case the head is long-produced..... *Nirvaniidæ*.
- c*¹. Basal suture of front usually obsolete, the basal lateral sutures running to and terminating at or near the ocelli; vertex usually clearly connate with the front, only in highly specialized groups with a sharp edge or with transverse carinæ on anterior border; ocelli on anterior border of head or above it..... *Jassidæ*.
- b*². Vertex more or less roundly curved on to face, and broadly visible in facial view, the ocelli facial and between the eyes or above them; basal suture of front, when present, far anterior to base of face; that portion of vertex visible from above usually very short and broad..... *Bythoscopidæ*.

PAROPIIDÆ

(Megophthalmidæ)

One has only to study *Paropia* and *Stenocotis* or *Kyphocotis* (Plate 1, fig. 2) side by side to realize their close relationship in essential structure. From my previous account of this subfamily was omitted the genus *Mesoparopia* Matsumura,¹⁰ described as of this family, with two species, *M. nitobei* from Formosa and *M. fruhstorferi* from Tonkin.

ULOPIDÆ

A reëxamination of material in this family makes clear a close relationship with *Paropia* and *Stenocotis*. The apparent absence of ocelli is a character of little value. In related genera ocelli may be very small and weak, and, in the confusion of coarse pits over the ocellar area, rudiments of ocelli might easily exist but be indistinguishable. It should not be stated that they are "absent" until microscopical sections are made of the ocellar area. The relationship of *Ulopa* and *Paropia* is evident from the accompanying figure (Plate 1, fig. 3, *b-e*) which shows frontal and lateral views of the side of the face in both of these genera.

The examination of material of the genus *Moonia* Distant has been made possible through the kindness of the director of the Zoölogical Survey of India. This shows at once, what had been suspected, that this genus is one of the Ulopidae and very closely related to *Ulopa*, from which it differs most conspicuously in the shorter vertex—a minor character. The structure of its face shows that *Mesargus* Melichar¹¹ should be placed in this family. Distant¹² notes its similarity to *Moonia*. *Radhades*, *Sitades*, and *Durgades* of Distant show some superficial resemblance to *Moonia*, but apparently belong near *Nehela*. *Ulopa* and *Moonia* possess a character that is unique among jassoid insects; namely, strongly rounded genæ, the sharp outer edge of which curves mesad to the front above the loræ, the lower margin passing beneath the loræ, leaving the latter with the outer border apparently free, in facial view. These two genera correspond in various other essentials. *Daimachus* Distant, placed in the Ledridæ, is *Ulopa*. *Gubela*, also placed in the Ledridæ, is very close to *Ulopa*. *Sichaea* Stål appears to be related to *Ulopa*.

¹⁰ Annot. Zool. Japon. 8 (1912) 27.

¹¹ Homop. Ceylon (1903) 176.

¹² Fauna Brit. India, Rhynch. 4 (1908) 313.

KOEBELIIDÆ

The genus *Koebelia* with the species *californica*, was described by me twenty-five years ago for a very peculiar and isolated western American type, for which I suggested the family name Koebeliidæ.¹³ At that time I possessed specimens of both *Ulopa* and *Paropia*, but did not realize their relationship, since the facial characters seemed to be very distinct from either. Not until material of *Stenocotis* came to hand did the relationship appear clear, the genus lying between *Stenocotis* and *Ulopa*, though very distinct from either (Plate 1, fig. 3, a). VanDuzee lists the genus under the "Paropiinæ," synonymizing Koebeliidæ with this subfamily. This is an entirely erroneous disposition of it, since it is far more closely related to *Ulopidæ* than to *Paropiidæ*. Moreover, the characters which separate it are entirely equivalent in value to those of the other families of this series. The strong dissimilarity between it and either *Ulopa* or *Paropia* is evident in important facial characters (Plate 1, fig. 3, a). However, its intermediate position between *Ulopa* and *Paropia* on the one hand and the *Stenocotidæ* sens. str. on the other is also indicated by comparison of the figures of *Koebelia* and *Kyphocotis tessellata* Kirkaldy (Plate 1, fig. 2, b).

SIGNORETIIDÆ

In my first paper on this group it was quite by chance that the two species of *Signoretia* treated represented two natural divisions of the genus, one with a short swollen declivous head, the other with a longer, less-swollen head, held in the long axis of the body. The collection of abundant material of true *S. malaya* Stål, at Singapore, enables me to identify certainly *S. malaya* of my former paper as merely a geographical form of it. In his descriptions Distant gives no specific structural characters for the two apparently very distinct species *S. aureola* Distant and *S. greeni* Distant, so that it is impossible to judge of their relationships. Characteristic of this family are the very small and short loræ.

Synopsis of genera.

- α^1 . Basal cell of clavus small and without cross veins; pronotum with two rudimentary submedian carinæ crossing the anterior transverse furrow or with a more or less complete median carina..... *Signoretia* Stål.
 α^2 . Basal cell of clavus large and with two cross veins (additional cross veins may occur); pronotum with two complete submedian carinæ.
 Preta Distant.

¹³ Psyche 8 (1897) 76.

Genus *SIGNORETIA* Stål*Synopsis of species.*

- a*¹. Plane of vertex subhorizontal, not declivous, and not in line (profile) with anterior curve of pronotum; front gently convex; pronotal median carina entirely absent; distinct, short, submedian longitudinal ridges crossing the anterior transverse depression; margin of basal cell of clavus about three times as long on the commissure as on the anal margin.
- b*¹. Pronotal submedian longitudinal ridges crossing anterior depression strong, sharply raised; intersections between thimble pits of pronotum sharp and strong; without black spots; length of female, 6 to 7 millimeters..... *S. malaya* Stål.
- b*². Pronotal submedian ridges low, broad, scarcely distinguishable; intersections between thimble pits of pronotum low, broad, and smooth; with black spots on head and pronotum; length of female, 9 millimeters..... *S. maculata* sp. nov.
- a*². Plane of vertex strongly declivous in line (profile) with anterior curve of pronotum; front strongly swollen on apical two-thirds; pronotal median carina present, at least anteriorly, the submedian longitudinal ridges lacking; margin of basal cell of clavus little longer on commissure than on anal margin.
- b*¹. Pronotum longer than wide; ocellus distant from eye its own diameter or little more.
- c*¹. Pronotal median carina broad, callose, complete; pale colored throughout; median carina of vertex confined to base or wanting.
- d*¹. Pronotal carina strongly raised anteriorly; the subapical cell subequal in length to the small triangular outer apical cell; head with dark spots; disk of vertex with a median carina basally..... *S. carinata* sp. nov.
- d*². Pronotal carina not strongly raised anteriorly; the subapical cell much longer than the small triangular outer apical cell; head without dark spots; disk of vertex without a median carina.
S. tagalica Baker.
- c*². Pronotal carina confined to anterior half, high and strong where it crosses the anterior depression; abdomen largely black and with dark markings elsewhere; median carina of vertex complete.
S. bilineata sp. nov.
- b*². Pronotal length less than the width; ocellus distant from eye about twice its own diameter; pronotal median carina confined to anterior half; body strongly marked with black, the males much darker *S. benguetensis* sp. nov.

Signoretia malaya Stål.

Study of a large series of specimens of this species obtained at Singapore and Penang, show that the Philippine specimens reported as this species were correctly determined.¹⁴ However,

¹⁴ Philip. Journ. Sci. § D 10 (1915) 194.

since the Philippine form averages larger than the typical form, it may be distinguished by the varietal name *philippinensis*. While a very common insect at both Singapore and Penang, it has been very infrequently encountered in the Philippines; but the latter statement means little, due to our scant knowledge of the Philippine field.

Signoretia maculata sp. nov. Plate 1, fig. 4.

Pale ochraceous (probably more or less virescent in life); a large oblique spot in each lateral area of vertex, a small median quadrangular spot near anterior margin of pronotum, a small elongate median spot near posterior margin; entire costal margin (more strongly basally), claval suture, and commissural margin piceous. Tegmina subhyaline, the veins concolorous. Median vein broadly infuscated, the other veins basally, concolorous with surface. Length of female, 19 millimeters.

Length of face (Plate 1, fig. 4, *c*) a little greater than width across eyes. Front and clypeus ridged as in *S. malaya*, but the swollen median elevation of the clypeus (Plate 1, fig. 4, *b*) is somewhat nearer the base than in that species. The upper bordering carina of the ocellar area is not continuous across the anterior margin of crown as in *S. malaya*, but runs out on the smooth surface of the crown before reaching median line. Ocellus distant the length of its own diameter from the eye. Length of vertex less than half its width between the eyes. Disk of vertex not so strongly depressed as in *S. malaya*, the surface minutely sparsely roughened but not tuberculate, the median carina low, broad, and indistinct; each lateral area with a delicate curved median carina which anteriorly joins the inner end of the supraocellar carina. Pronotum (Plate 1, fig. 4, *a*) about four times length of vertex; the anterior lateral margin a little more than three times into the width; marginal carina and pleura (lateral view) as in *S. malaya*. The thimble pitting of pronotum is coarser than in *S. malaya*, the intersections between pits being broader, lower, and smoother, particularly near anterior border. The two short submedian longitudinal ridges crossing the anterior depression in *S. malaya* are here obsolete.

INDIA, Darjeeling district, Mangpu, Sureil, elevation, 1,500 meters (*S. W. Kemp*). Described from one specimen kindly loaned to me by the director of the Zoölogical Survey of India. This species may possibly find a close relative in *S. greeni* Dis-

tant, when the structural characters of that species become known.

Signoretia carinata sp. nov. Plate 1, fig. 5.

Pale ochraceous throughout, the vertex and pronotum with a whitish waxy bloom. Tegmina opaque, albescent; veins of corium concolorous; costal margin apically and apical margin slightly infuscated. Length of female, 7 millimeters.

Length of face (Plate 1, fig. 5, *c*) less than the width across eyes. Face of the *S. tagalica* type, the median frontal ridge passing but shortly and indistinctly on to clypeus, the anterolateral depressions of clypeus large, deep, and leaving but a narrow ridge between them anteriorly. The supraocellar carina is weak and coalesces with the lateral extremity of subocellar carina about halfway between eye and median line; subocellar carina sharp, strong, and continuous along the crown. Ocellus distant the length of its own diameter from eye. Length of vertex less than half width between eyes; concavity of vertex deep, rugosely roughened, and with a distinct longitudinal median carina on basal half. Pronotum (Plate 1, fig. 5, *a*) about three and a half times length of vertex; the anterior lateral margins about four and a half times into the width; marginal carina (lateral view) and pleura similar to those of *S. malaya*; thimble pitting very similar to that of *S. malaya*; with a complete median carina which is stronger anteriorly where it crosses the transverse depression. That portion of pronotum anterior to transverse depression in this species, as in *S. tagalica*, is longer and flatter than in *S. malaya*, and the transverse depression is not so broad laterally. Margin of basal cell of clavus little longer on the commissure than on the anal margin.

MINDANAO, Agusan Province, Butuan (*Baker*). The southern representative of *S. tagalica*, but quite distinct. It will now be of no little interest to examine material belonging to this section of the genus from the intervening islands.

Signoretia bilineata sp. nov. Plate 1, fig. 6.

Pale ochraceous, the pronotum whitish; lateral ridges of front and discal concavities of vertex brownish; a narrow brownish stripe, interrupted by the transverse depression, flanking median carina on either side, on anterior half of pronotum. Tegmina sordid albescent, the apical veins and the apical submargin fuscous. Length of female, 6.4 millimeters.

Length of face (Plate 1, fig. 6, c) less than the width across eyes. Face of the *S. tagalica* type, the strong median ridge running out at clypeal suture; basal border of front concave in facial view. Supraocellar carina weak but traceable across anterior portion of crown near and parallel to subocellar carina which sharply borders anterior margin of crown, the latter carina depressed to the level of the discal concavities of vertex; ocellus distant the length of its own diameter from eye. Length of vertex less than half width between eyes; concavities of vertex shallow, with a strong complete median white carina. Front in lateral view (Plate 1, fig. 6, b) strongly and rather abruptly swollen on lower half. Pronotum (Plate 1, fig. 6, a) about three and a half times length of vertex, the anterior lateral margins into the width a little more than three times; marginal carina (lateral view) and pleura similar to those of *S. malaya*. Intersections between thimble pittings of pronotum narrower than in *S. maculata* but also low and smooth; median carina distinct only on anterior half, very strong where it crosses the anterior depression. Margin of basal cell of clavus about a half again longer on the commissure than on the anal margin.

BORNEO, Sandakan (Baker).

Signoretia benguetensis sp. nov. Plate 1, fig. 7.

Female pale ochraceous; dorsum of abdomen, except segmental margins, black; median carina of front and lateral ridges brownish; two small spots at apex of vertex and two large spots at base black; a median longitudinal piceous band on pronotum, extending from transverse depression to base of pronotum, broader posteriorly. Tegmina translucent, the veins of corium and clavus slightly infuscated. Length, 6.5 millimeters.

Male with dark markings more deeply colored and more extensive. Frontal carina black, all bordering carinae of vertex broadly deep black; pronotum largely washed with blackish. Tegmina palely infuscated throughout, the veins darker, claval veins blackish. Length, 6 millimeters.

Length of face (Plate 1, fig. 7, c) less than width across eyes. Face similar to that of *S. bilineata*, but the front in lateral view (Plate 1, fig. 7, b), though swollen, is evenly curved from base to apex and not strongly suddenly protuberant below; antero-lateral depressions of clypeus narrow, the latter with a dark spot at middle; lateral ridges of front very strong. The supraocellar carina is weak anteriorly and joins subocellar carina

nearer to median line than to ocellus, the subocellar carina sharply bordering anterior margin of crown, which is subtruncate; basal carina of vertex very thin and sharp; concavities of vertex deep, the anterior margin strongly raised, the median carina subobsolete, the surfaces minutely roughened and subdivided by low indistinct intermediate ridges, which parallel the lateral and basal carinæ; ocellus distant from eye about twice its diameter. Length of vertex less than half width between eyes, but greater than lateral margin of pronotum, as in *S. carinata*. Pronotum (Plate 1, fig. 7, *a*) three times length of vertex, the anterolateral margin about five times into the width; marginal carina (in lateral view) straight, the pleura with an irregular fold near posterior margin and a vertical median series of large elongate pits; thimble pits of pronotum very large, somewhat irregular, the intersections narrow but low and smooth; transverse depression nearer to foremargin than in other species, the median carina on anterior half of pronotum sharp and strong but depressed where it passes the transverse depression. Margin of basal cell of clavus somewhat longer on the commissure than on the anal margin.

LUZON, Benguet Province, Pauai (Haight's Place), altitude, 2,400 meters (*Baker*). This species presents the only case in the family known to me of strongly marked sexual dimorphism. It may possess relationships with *S. sumatrana* Schmidt, which may exhibit a similar dimorphism, but this cannot be known until the structural characters of *S. sumatrana* are described.

Genus PRETA Distant

Synopsis of species.

*a*¹. Head and thorax long; thimble pitting of pronotum weak but distinct; tegminal appendix well formed and reaching apex; subapical cell about as long as width of succeeding apical cell.

P. gratiosa Melichar.

*a*². Head and thorax short; thimble pitting of pronotum obsolete, the surface smooth; tegminal appendix reduced, reaching about halfway from apex of clavus to apex of tegmina; subapical cell much longer than width of succeeding apical cell. *P. luzonensis* sp. nov.

Preta gratiosa Melichar. Plate 1, fig. 8.

Melichar, Homop. Ceylon (1903) 160 (*Signoretia*).

Pale ochraceous (virescent in life); fore and middle tibiæ, apically, and tarsi darker. Corium and membrane subhyaline, the apical veins a little infuscated, clavus opaque, whitish.

Vertex and pronotum commonly covered with a white waxy bloom. Length, female, 7 millimeters; male, 6.5.

Length of face (Plate 1, fig. 8, c) nearly a third greater than width across eyes. Face as in *Signoretia malaya* but clypeus narrower, its basal suture more strongly curved and facial ridges extended to apex. The supraocellar carina continuous over the crown of the head some distance from and subparallel to subocellar carina, the latter bordering crown in front as a sharp porrect margin. The two concavities of vertex slope gradually caudad, deeper at inner basal angles next the median carina, which is strong and complete. Ocellus distant from eyes about its own diameter. Length of vertex a little more than three-fourths width between eyes and half again longer than anterolateral margin of pronotum. Pronotum (Plate 1, fig. 8, a) about twice length of vertex; the anterolateral margin into width a little more than two and a half times; marginal carina and pleura as in *Signoretia malaya*; thimble pitting large but shallow and inconspicuous; two submedian carinae corresponding to the two rudiments found in *Signoretia malaya* pass from fore to hind margin, diverging somewhat caudad, and are high, sharp, and strong throughout. Venation of corium and membrane as in *Signoretia malaya*, but pitting along veins very inconspicuous and apically entirely lacking; conspicuous pitting occurs only at base of subcostal area and along claval vein at base; basal cell of clavus very large and with two oblique cross veins.

STRAITS SETTLEMENTS, Singapore and Penang (*Baker*). This species was found to be abundant in both of these regions, and a slightly different geographical form of it is common at Sandakan, Borneo. A similar form is to be expected in Tawitawi and elsewhere in the Philippines since the genus ranges to northern Luzon. This species is referred to *P. gratiosa* Melichar, described from Ceylon, and recorded by Distant¹⁵ from Tenasserim, but with some doubt, since the figures of Distant and Melichar differ widely in details, though the present form is likely to prove the same, at least, as that from Tenasserim.

Preta luzonensis sp. nov. Plate 1, fig. 9.

Pale ochraceous (more or less virescent in life); median keel and lateral ridges of face slightly darkened; tegmina trans-

¹⁵ Fauna Brit. India, Rhynch. 4 (1908) 234.

lucent, the veins pale ochraceous. Length, female, 7 millimeters; male, 6.5.

Length of face (Plate 1, fig. 9, c) subequal to its width. Face very similar to that of *Signoretia malaya* even in proportions; facial keel extending to middle of clypeus, though not so strong on clypeus as on front; the whole anterior portion of clypeus strongly but not equally depressed; front very slightly convex in profile (Plate 1, fig. 9, b). Ocellar carinæ and carinæ of vertex as in *P. gratiosa*. Ocellus a little farther from eye than its own diameter. Length of vertex less than half width between eyes, and subequal to anterolateral margin of pronotum. Pronotum (Plate 1, fig. 9, a) a little more than three times length of vertex; the anterolateral margin into width a little more than three times; thimble pitting entirely obsolete except for faint indications along lateral borders; submedian carinæ similar to those of *P. gratiosa*, as is also the venation.

LUZON, Benguet Province, Baguio (*Baker*). Not uncommon. This very distinct species has the cephalic and thoracic proportions of *Signoretia malaya*, but the pronotal carinæ and claval venation of *Preta gratiosa*. It differs from all other members of the family in lacking the thimble pitting on pronotum.

EUACANTHIDÆ

The accompanying figure (Plate 1, fig. 10) will make it clear that in *Euacanthus* we are dealing with a type that not only is closely related to *Signoretia* and *Pythamus* in several fundamental respects, but that also shows no affinity to the Tettigoniellidæ where it is usually placed. It is, in its way, as isolated a type as either *Ulopa* or *Paropia*. The position of the ocellus with the peculiar accompanying structures is similar to that of the Signoretiidæ and Pythamidæ, as is the tegminal venation.

Bundera Distant¹⁶ apparently belongs here, but the ocelli are not mentioned in the generic description.

PYTHAMIDÆ

There can be no doubt of the interrelationship of *Onukia* and *Pythamus* on the one hand, and *Onukia* with *Tortor* and *Dryadomorpha* on the other. The structure of the pronotum, as in the case of *Muirella*, suggests certain Jassaria, but the cephalic characters are of greater importance and are unmistakable. Dis-

¹⁶ Fauna Brit. India, Rhynch. 4 (1908) 228.

covery of species of *Pythamus* with the laminate cephalic carina very weak makes this relationship clearer. Both *Apphia* and *Omaranus* of Distant belong to this family, as noted under *Onukia*. The collection of more material of *Tortor* and *Dryadomorpha* in Queensland is greatly to be desired.

In all genera of this family the pronotum is truncate or slightly incurved posteriorly; the anterolateral carinae of vertex reach apex or nearly so; the sides of front are very shallowly sinuate opposite antennal scrobes; the clypeus is strongly narrowed apically.

Synopsis of genera.

- a*¹. Tegmina of normal texture, the venation distinct throughout (except in *Oniella*); ocelli large.
- b*¹. Sides of pronotum strongly converging cephalad; head much narrower than pronotum.
- c*¹. Median carina of vertex, in part at least, laminately raised, the disk of vertex strongly concave on either side of the lamina, the basal margin strongly and sharply raised; pronotal median carina present or wanting..... *Pythamus* Melichar.
- c*². Median carina of vertex not laminately raised, sometimes weak or obsolete apically; surface of vertex slightly concave, plane or slightly convex; basal margin not strongly raised; pronotum without median carina.
- d*¹. Posterolateral carina of vertex distinct throughout, the ocelli pushed forward into facial view as in other genera; median carina of vertex distinct; clypeus narrowly rounded apically; tegmina with venation distinct throughout. *Onukia* Matsumura.
- d*². Posterolateral carina of vertex obsolete, and anterolateral portion weak, the ocelli thus resting on plane of crown and not visible in facial view; median carina of vertex obsolete; clypeus subtruncate apically; tegmina with venation obscure basally.
Oniella Matsumura.
- b*². Sides of pronotum straight in long axis of body, the head little narrower *Chudania* Distant.¹⁷
- a*². Tegmina coriaceous, venation at least partly obscure and indistinguishable; ocelli small and weak or indistinguishable.
- b*³. Head in profile not thin, similar to *Onukia*; clypeus widened apically; loræ wider than anterior part of clypeus; front not concave; pronotal lateral carinae evanescent..... *Dryadomorpha* Kirkaldy.¹⁸
- b*². Head in profile thin; front concave; loræ minute..... *Tortor* Kirkaldy.¹⁸

Genus *PYTHAMUS* Melichar

Synopsis of species.

- a*¹. Vertex strongly produced, distinctly longer than pronotum; front somewhat concave in profile; pronotum in part very finely transversely

¹⁷ The position of this genus is uncertain.

¹⁸ *Tortor* and *Dryadomorpha* are referred here provisionally.

aciculate and sparsely punctate and without trace of median carina; scutellum shagreened, clavus punctate only along veins; front shagreened..... *P. productus* sp. nov.

a². Vertex subequal in length to pronotum; front always convex in profile.

b¹. Pronotum short, width twice the length; scutellum distinctly shorter than vertex; pronotum coarsely transversely wrinkled and without trace of median carina; scutellum rugose at base; clavus punctate only along veins; front rugose..... *P. decoratus* sp. nov.

b². Pronotum long, width much less than twice length; scutellum subequal to vertex in length; pronotum closely, deeply, grossly thimble pitted, as are also scutellum and clavus; pronotum with a distinct median carina on anterior two-thirds or at least a trace of one; face shagreened..... *P. melichari* Baker.

c¹. Whitish costal border of tegmina with two large inwardly projecting albescent lobes or spots; vertex longer than width across anterior margins of eyes..... *P. melichari* Baker var. *bilobatus* var. nov.

c². Whitish costal border of tegmina without inwardly projecting lobes; length of vertex subequal to width across anterior margin of eyes.

d¹. Pale costal border of tegmina expanded into radial cell; entire apical area of scutellum and two dots anterior to it yellow; black of dorsum without strong bluish reflections; size small.

e¹. Loræ not black.

f¹. Lateral spots of vertex broadly connected with the large median triangular basal spot..... *P. melichari* Baker.

f². Lateral spots of vertex not connected with the very small median basal spot.

P. melichari Baker var. *singaporensis* var. nov.

e². Loræ black..... *P. melichari* Baker var. *mindanaensis* Baker.

d². Pale costal border of tegmina not expanded into radial cell; only extreme apex of scutellum yellow; black of dorsum with a strong bluish reflection; size large.

P. melichari Baker var. *borneensis* var. nov.

Pythamus productus sp. nov. Plate 2, fig. 11.

Pale ochraceous; lateral margins of genæ, margins of front, frontal carina, two submedian stripes on front, and lateral stripes on clypeus pale brown. A supra-antennal dot and a smaller marginal dot above it black. Vertex with an irregular transverse black band on anterior half. Pronotum shaded with brownish, especially anteriorly. Scutellum with large triangular basal spots halfway between lateral angles and median line, a minute dot between each of these and median line and a fine median line reaching to transverse furrow brownish, the larger spots darker. Tegmina sordid whitish translucent, the veins broadly brownish; a larger smoky spot at middle of subcostal area, and two smaller ones on apical third, with two irregular subapical concentric stripes of the same color. Abdomen clouded with brownish. Apices of hind tibiæ and tarsi brownish. Length of female, 8 millimeters.

Length of face (Plate 2, fig. 11, *c*) a little more than one and a half times the width across eyes. Loræ smooth; genæ obscurely and transversely rugose near lateral margins; front shagreened; lateral surfaces of raised basal portion of frontal ridge rugose. Supraocellar carina sharply bordering anterior margin of vertex, subocellar carina weak and irregular but distinct from near ocellus to apex of front; area between these carinæ and to the supra-antennal carina irregularly transversely wrinkled. The ocellus lies below and touches the superior carina and is distant from eye about three times its diameter. While the outlines of front are distinct in facial view, the lateral suture actually becomes obsolete just above the supra-antennal carina. Lamine carina of vertex highest on anterior half, the lateral concavities in deeper anterior portion sub-obsolete concentrically wrinkled at sides, smooth in shallow posterior portion. Length of vertex nearly a third greater than width between eyes. Pronotum (Plate 2, fig. 11, *a*) slightly shorter than vertex, the anterolateral margin into width three and a half times, the hind margin subtruncate; a broad median basal area reaching forward to three-fourths of length, minutely thickly transversely aciculate; remainder of surface on posterior half with sparse subobsolete punctures, on anterior half smooth, without trace of median carina. Scutellum wider than long and about three-fourths length of pronotum, otherwise as in *P. melichari*. Veins in tegmina weakly and subobsoletely pit margined, the surface of clavus smooth. Several supernumerary cross veins occur in both clavus and corium, one of these forming an inner subapical cell. The subgenital plate of female is deeply broadly emarginate, beyond apex of emargination and at sides strongly callosely swollen.

STRAITS SETTLEMENTS, Penang Island (*Baker*). The largest and most conspicuous species of the genus.

Pythamus decoratus sp. nov. Plate 2, fig. 12.

Face, sternites, most of vertex, anterior margin and a connected median stripe on pronotum, basal angles of scutellum, and an irregular median stripe extending from base to transverse furrow black. Anterolateral borders of head, eight small spots arranged around margin of vertex, and submedian and apical areas of scutellum yellowish. Pronotum in large part and veins of tegmina testaceous. Legs pale ochraceous; abdomen with pale brown segmental margins. Tegmina very dark smoky, two adjoining subcostal spots albescent, the proximal smaller; ex-

treme apical margin albescent, a concentric subapical stripe subhyaline. Length of female, 6.25 millimeters.

Length of face (Plate 2, fig. 12, *c*) a little less than one and a half times width across eyes. Face including loræ, apical area of genæ, and most of clypeus thickly rugose; clypeus shagreened on median basal area; genæ beneath eyes subobsoletely sparsely transversely wrinkled. Subocellar carina curving downward toward supra-antennal carina, three strong transverse carinæ between this and ocellus, the upper one subtending the ocellus; area between ocellus and supra-antennal carina also with numerous fine transverse wrinkles. Ocellus touching the normal supraocellar carina and distant from eye more than three times its diameter. Lamine carina of vertex highest at middle, tapering equally either way. Lateral concavities of vertex deepest at middle, sloping rapidly upward to carinæ in all directions and concentrically wrinkled throughout. Length of vertex a fourth greater than width between eyes. Frontal profile (Plate 2, fig. 12, *b*) abruptly prominent above the clypeus.

Pronotum (Plate 2, fig. 12, *a*) nearly as long as vertex, the anterolateral margin into width four and a half times, the hind margin very slightly incurved, the surface to near foremargin sparsely shallowly punctured and transversely wrinkled, and without trace of median carina. Scutellum much wider than long, basal angles shagreened, median basal area rugose, apical area very minutely longitudinally wrinkled. Entire clavus and the basal two-thirds of corium punctate. With several supernumerary cross veins, one forming a median subapical cell, two other strong cross veins occurring in the medial area as in *Deltocephalus*. The subgenital plate of female is shallowly broadly angularly emarginate, a blackish spot occurring beyond the apex.

BORNEO, West Borneo, Mowong (*Muir*). A small species, but one of the most highly ornamented in the genus. The lower part of the front in this species and in *P. productus* (in lateral view) is more prominent than in other species of the genus.

Pythamus melichari Baker.

In each Malayan region in which collecting has been done, we have encountered forms very closely related to *P. melichari* described from Palawan. These are all very close to *melichari* in structure, differing only in size, in minor details of markings, and in minor structural characters. In the various regions the varieties or subspecies, as we may choose to call them, present

a remarkable uniformity. It is probable that each island and distinct geographical subregion will furnish its own peculiar form of this plastic species. One of these forms has already been described under the name *mindanaensis*.¹⁹ Three more are presented herein. The relationship of any of these forms to *Pythamus dealbatus* Melichar will remain an open question until that species can be reëxamined.

Pythamus melichari Baker var. *bilobatus* var. nov. Plate 2, fig. 13.

Lower parts largely ochraceous, upper parts largely black. Face and clypeus slightly brownish, the lateral margins of front and basal lateral margins of clypeus blackish. Mesopleura, dorsum of abdomen except basal lateral margins, outer margins of anterior tibiæ, and ovipositor black. Vertex with a narrow irregular transverse band, broader laterally before apex, and a small oval spot next each eye, yellowish lateral margins of pronotum, apex of scutellum, and two dots just before it yellowish. Extreme base of tegmina yellowish, an albescent subcostal spot next this, a larger oval albescent spot on subcostal stripe at middle extending halfway across corium and with a narrow band extending from its inner margin to claval suture; apical margin broadly albescent; remainder of tegmina black. Length of female, 6.25 millimeters.

Length of face (Plate 2, fig. 13, *c*) one and a half times width across eyes. Front, clypeus, and loræ shagreened throughout, the genæ smooth. The subocellar carina is as strong as the supraocellar and curves downward to opposite the supra-antennal carina and twice length of latter from eye; from halfway between the extremity of the subocellar carina and the antennal scrobe a strong vertical carina passes along the line of the frontal suture, then toward the ocellus; in the triangular area between these carina and the supraocellar there are about fourteen transverse wrinkles, the alternate spaces between which are finely rugose; supra-antennal area finely transversely wrinkled. Ocellus touching the normal supraocellar carina and a little more than three times its diameter from eye. Laminate carina of vertex more strongly raised at middle and anteriorly than posteriorly. Lateral concavities of vertex deepest at middle, sloping rapidly upward to carinæ in all directions and concentrically wrinkled throughout. Length of vertex a third greater than width between eyes. Pronotum (Plate 2, fig. 13, *a*) nearly as long as vertex, the anterolateral margin into width a little

¹⁹ Philip. Journ. Sci. § D 10 (1915) 200.

more than three times, the hind margin shallowly subangularly emarginate; with a distinct median carina on anterior two-thirds; median area and basal lateral margins of scutellum very coarsely but shallowly thimble pitted; the yellow apical area of scutellum and two lateral dots before it callose and smooth. Tegmina with clavus grossly thimble pitted basally, apically the pits become subobsolete, and largely wanting in the albescent subcostal spots; without supernumerary cross veins.

BORNEO, Sandakan (*Baker*).

Pythamus melichari Baker var. *singaporensis* var. nov. Plate 2, fig. 14.

Differs from var. *bilobatus* as follows: Mesopleura with only a small blackish mark anteriorly. Ovipositor dark only at apex. Lateral yellow spots on vertex large and reaching basal carina; transverse band before apex of different shape (Plate 2, fig. 14, *a*). Pale area of tegminal subcostal area expanded into medial area and proximad of medial area. Length of female, 6.5 millimeters.

Length of vertex a fourth greater than width between eyes. Pronotum (Plate 2, fig. 14, *a*) as long as vertex, the anterolateral margin into width three and a half times. Apical area of scutellum basally sparsely strongly punctate.

STRAITS SETTLEMENTS, Singapore and Penang (*Baker*).

Pythamus melichari Baker var. *borneensis* var. nov. Plate 2, fig. 15.

Differs from var. *bilobatus* as follows: Black of dorsum with strong bluish reflection. Transverse band before apex of vertex of different shape (Plate 2, fig. 15, *a*). Pale area near outer margin of tegmina small and narrow and confined to subcostal area. Tegmina equally dark to the albescent apical border. The usual ocellar black spot invades a large part of ocellar area; the usual antennal spot occupies entire scrobe and invades lateral margin of front; upper outer angle of genæ black. Length of female, 7 millimeters.

Length of vertex a fourth greater than width between eyes. Pronotum (Plate 2, fig. 15, *a*) as long as vertex, the anterolateral margin into width three times. Apical area of scutellum entirely rugose-punctate.

BORNEO, Sandakan (*Baker*). This brilliant form, so distinct in appearance, is yet very close to *melichari* in all essential structural characters. The figure of the tegmen (Plate 2, fig. 15, *d*) shows the simple type of venation common to *melichari* and its

varieties. Comparing this with *Signoretia* it is to be noted that the area corresponding to an outer subapical cell in that genus, is here entirely confluent with the fourth apical cell.

Genus *ONUKIA* Matsumura

Matsumura, Annot. Zool. Japon. 8 (1912) 44.

Type, *Onukia onukii* Matsumura.

Distant has redescribed this genus in the Tettigoniellidæ under the name of *Apphia*.²⁰ He does not mention the ocelli or the peculiar structures connected therewith. The genus *Omaranus*, immediately following *Apphia*, also belongs to the Pythamidæ, as the general structure and the position of the antennæ clearly indicate. Here again, neither the exact position of ocelli nor the accompanying structures are described.

Synopsis of species.

- α^1 . Vertex in large part strongly longitudinally obliquely wrinkled; superior frontal (subocellar) carina as strong and sharp as anterior bordering carina of vertex; vertex and pronotum black.
- b^1 . Supra-antennal ledge acutely pointed toward scrobe, flanked by deep grooves; tegmina translucent with smoky markings. *O. onukii* Matsumura.
- b^2 . Supra-antennal ledge broadly curved above scrobe and not flanked by grooves; tegmina shining opaque black except for subcostal markings..... *O. corporaali* sp. nov.
- α^2 . Vertex almost entirely without longitudinal oblique wrinkles; superior frontal carina weak, conspicuously less strong than anterior carina of vertex; vertex and pronotum ochraceous or reddish, the former with a black spot, the latter with a dark crossband.
- b^1 . Width of vertex at base much more than half of pronotum; tegmina carmine except at apex; size small..... *O. muirii* sp. nov.
- b^2 . Width of vertex at base less than half width of pronotum; tegmina yellow except entire subcostal area; size large.. *O. kelloggii* sp. nov.

Onukia onukii Matsumura. Plate 2, fig. 16.

Matsumura, Annot. Zool. Japon. 8 (1912) 44.

This well-marked species, the type of the genus, has a very close general resemblance to *Pythamus melichari* except in the median carina of vertex.

The front, clypeus, and loræ are coarsely shagreened, the genæ are transversely wrinkled below the eye and longitudinally wrinkled near the outer margin. The lateral portions of front

²⁰ Fauna Brit. India, Rhynch. 7 (1918) 4.

are rather strongly and abruptly convexly raised above the lateral sutures, the disk rather strongly convex from side to side and divided by the strong, sharp, complete median carina which does not extend on to clypeus. Supraocellar carina as in *Pythamus*, but the subocellar carina passes down and to the side, closer to it, making the ocellar area narrowly long triangular (Plate 2, fig. 16, *b*); the frontal suture is very strong and deeply cut above the scrobe, curves around the extremity of the subocellar carina, and extends as a delicate carina medially through the ocellar area toward apex of front, being the only carina within this area, except one above this still more delicate and immediately subtending ocellus; surface of ocellar area coarsely shagreened like the front. Supra-antennal area finely transversely wrinkled throughout, strongly depressed along eye margin, this with the effect of the deep-cut frontal suture giving it the appearance of being produced to a point at the upper border of scrobe. Ocellus in the usual position for *Pythamus*, about two and a half times its diameter from eye. Vertex a little longer than wide, narrowed to an acute apex, the upper lateral portions of face broadly visible in dorsal view (Plate 2, fig. 16, *a*); median carina sharp and strong, of equal height throughout, but not laminately raised, lateral areas gently concave, the surface finely longitudinally obliquely wrinkled except near carina basally. Pronotum shorter than vertex, the anterolateral margin into width four and a half times; surface strongly transversely wrinkled except near anterior border, as in *Pythamus decoratus*. Entire basal area of scutellum thickly finely punctate and coarsely shagreened, the apical area finely rugose. The scutellum, as in all species of the genus, is proportionally larger than in *Pythamus*, and as in all but one (*kelloggii*) longer than the pronotum. Entire clavus, base of corium, and borders of veins subobsoletely punctured; two well-defined cross veins in distal half of subcostal area (Plate 2, fig. 16, *d*). Hind tibiae even more strongly long spiny than in *Pythamus*.

JAPAN (*Matsumura*).

Onukia corporaali sp. nov. Plate 2, fig. 17.

Pale ochraceous below, intense shining black above; upper half of entire face and propleuræ black. Subcostal area of tegmina pale testaceous as far as an oblique black stripe at two-thirds of length; beyond this a large triangular decolored area which extends mesad across apical portion of radial cell; the cross vein at middle of this area broadly carmine, the red ex-

tending into radial cell; tegmina otherwise shining black throughout; wings smoky. Length of female, 5 millimeters.

Differs from *O. onukii* in structure, as follows: The carinate continuation of lateral frontal suture passing through center of ocellar area and the carina immediately subtending ocellus are very strong and complete, as strong as supraocellar and subocellar carinae; the supra-antennal area less strongly depressed next eye and next frontal suture, sloping more gradually to antennal scrobe. Vertex as long as wide between eyes; oblique longitudinal wrinkles of disk very strong and confined to anterior half, entire basal portion shining and minutely sparsely punctured. Pronotum (Plate 2, fig. 17, a) a little shorter than vertex, the anterolateral margins into the width four and a half times; transverse wrinkles subobsolete, the surface sparsely punctate. Median basal area of scutellum subobsoletely rugose, the apical area as in *O. onukii*. With but one oblique cross vein in distal portion of subcostal area.

SUMATRA, Baroe, Bandar (*J. B. Corporaal*). One specimen of this beautiful species, which represents the farthest southwestern range of this genus as now recognized.

Onukia muirii sp. nov. Plate 2, fig. 18.

Pale ochraceous below; vertex basally and pronotum reddish; vertex with a large irregular median black spot on anterior half; pronotum with an anterior median stripe and a connected transverse median line blackish; scutellum blackish except for two subapical spots and extreme apex. Tegmina carmine to line of apical cross veins, beyond this testaceous with red veins. Length of female, 5 millimeters.

Differs from *O. corporaali* in structure, as follows: A second distinct transverse carina in the ocellar area between the median carina and that subtending the ocellus; also a transverse carina on basal lateral area of front near the subocellar carina and parallel with it. Vertex not as long as width between eyes; surface little depressed, plane, but slightly roughened and without oblique longitudinal wrinkles except immediately adjoining lateral carina. Pronotum (Plate 2, fig. 18, a) as long as vertex, the anterolateral margin into width about four times; surface very sparsely punctate, and medially with indications of subobsolete transverse wrinkles. Tegmina with venation as in Plate 2, fig. 18, d. External genitalia very large, as long as remainder of abdomen, the subgenital plate broadly shallowly angularly emarginate.

BORNEO, West Borneo, Mowong (*F. Muir*): British North Borneo, Sandakan (*Baker*). This conspicuous species is very abundant in Borneo.

Onukia kelloggii sp. nov. Plate 2, fig. 19.

Pale ochraceous, the pronotum a little darker. Front with a black dot on either side below antennæ. Vertex with a large irregular black spot on anterior half. Pronotum medially and along hind margin blackish. Tegmina pale yellowish to apical cross veins, brighter basally, the entire subcostal and apical areas decolored and hyaline. A dark spot at base of subgenital segment. Length of female, 7 millimeters.

Differs from *O. muirii* in structure, as follows: Sides of front much more gradually curved from disk to lateral suture. Ocellus distant from eye about four times its diameter. Vertex slightly longer than width between eyes. Pronotum (Plate 2, fig. 19, *a*) slightly shorter than vertex, the anterolateral margins into width about five and a half times, hind margin nearly truncate. Scutellum shorter than pronotum.

CHINA, Fukien Province, Foochow (*C. R. Kellogg*). A large conspicuous species. More specimens, representing both sexes, are much desired. This species is apparently closely related to *Onukia* (*Apphia*) *burmanica* Distant.²¹

Genus ONIELLA Matsumura

Matsumura, Annot. Zool. Japon. 8 (1912) 46.

Type, *Oniella leucocephala* Matsumura (Japan).

This genus is a weak, reduced edition of *Onukia*. It is however true here, as all through these allied families, that strong superficial resemblance may be accompanied by striking generic divergence in structural characters. As indicated in the generic synopsis and the accompanying illustration (Plate 2, fig. 20), this genus is well separated from *Onukia*.

Matsumura refers here two species from China described by Melichar as *Tettigoniella excelsa* and *T. honesta*.²² They appear to belong to this family; but since Melichar figures both of them with the head distinctly wider than the pronotum, it may be questioned if they belong in the genus *Oniella*.

In the paper above mentioned, Matsumura describes another species, *O. niisimae*, from Japan.

²¹ Fauna Brit. India, Rhynch. 7 (1918) 4.

²² Ann. Mus. Zool. St. Petersb. 7 (1902) 131, 132.

Genus **DRYADOMORPHA** Kirkaldy

Kirkaldy, Bull. Hawaiian Sugar Planters' Assoc. 1 (1906) 335.

Type, *Dryadomorpha pallida* Kirkaldy (Queensland).

Later Kirkaldy²³ described another species, *D. lotophagorum*, referred to this genus.

Genus **TORTOR** Kirkaldy

Kirkaldy, Bull. Hawaiian Sugar Planters' Assoc. 3 (1907) 42.

Type, *Tortor daulias* Kirkaldy (Queensland).

NIRVANIIDÆ

The members of this family formerly known have been variously treated. Distant places them with *Hecalus*. Kirkaldy located them first with *Spangbergiella* and afterward with the eupterygids. Lately, McAtee²⁴ regards *Nirvana* as one of the Eupterygidæ. All of these references are based upon superficial resemblance and are without any justification in comparative anatomy. These insects have no relationship with the eupterygids and but a superficial resemblance to *Hecalus* and *Spangbergiella*. Subapical veins in the tegmina are always evident by transmitted light, and occasionally one or more subapical cells are more or less clearly outlined. McAtee and some other authors have described the tegmen as without an appendix, but an appendix is always present, though sometimes much reduced and very narrow. The venation of wings is similar to that of typical Jassinæ.

The reference of *Stenomtopius* to this family might seem unnatural if it is compared only with *Nirvana*, but the transition to this extreme type occurs through *Pythonirvana*.

The study of species in this group is complicated by the fact that there exists in most of the genera a strong sexual dimorphism in the form of the head and some other characters, not noted by previous authors. The vertex of female is commonly a little larger and with a more strongly rounded apical margin than in the male, and the color markings of the male are usually more or less reduced. There may also be a sexual difference in form of apex of tegmina. Thus it seems probable that *Kana thoracica* and *K. ramificata* of Distant are the sexes of one species, and similarly that *K. illuminata* and *K. signata* are the sexes of

²³ Bull. Hawaiian Sugar Planters' Assoc. 3 (1907) 41.

²⁴ Proc. Biol. Soc. Washington 31 (1918) 118.

another. Distant does not mention the sex of the specimens described and gives no diagnostic structural characters.

The position of the ocelli in this family varies, from points on the crown in front of the eyes and near the margin to points on or below the anterior margin of crown, but always accompanied by peculiar and characteristic surrounding structures—and this in forms which in all other characters show the closest relationships, thus breaking down entirely the ancient definition of jassoid families based on position of ocelli alone. Such wide difference in position of ocelli is more apparent than real, since the relation of the ocelli to certain fundamental characters of head structure in this family is very much the same in all. The former lack of understanding of the Acocephalini, Hecalusaria, and many other jassoid groups has been due to neglect to examine the position of the ocellus as related to the course of the frontal sutures and the morphological limits of the true vertex where these can be identified.

It seems quite possible that some of the genera recently described²⁵ as eupterygids do not belong in that group, but will find their nearest relationships with this family; for instance, *Bolanus*, *Bolanusoides*, *Camulus*, and *Augulus*. Distant does not even mention the ocelli in any of these and does not mention wing venation, which is the basis of the present classification for the Eupterygidae. His genus *Anomiana* belongs in the Balcluthini, and *Chickkaballapura*, *Paivanana*, and *Empoascanara* are perhaps not eupterygids.

It seems quite probable that the genus *Mohunia* Distant²⁶ belongs to this family, judging from the face, form of vertex, and venation. For this genus, also, the position of ocelli is not described.

Atritona Melichar²⁷ is a good member of this family, but the structures surrounding the ocellus are not described; nor is the apical venation of tegmina, which would probably be distinguishable by transmitted light. The form of the head is unique. The genus was described from East Africa.

Likewise *Hodoedocus* Jacoby,²⁸ with *Kosasia* Distant²⁹ as a synonym,³⁰ is apparently a member of this family, judging

²⁵ Fauna Brit. India, Rhynch. 7 (1918).

²⁶ Op. cit. 4 (1908) 272.

²⁷ Acta Soc. Ent. Bohem. 11 (1914) 6.

²⁸ Sjöstedts Kilimandjaro-Meru Expedition Stockholm 12^r (1910) 126.

²⁹ Fauna Transvaal. 1 (1910) 240.

³⁰ Fide Melichar, loc. cit.

from the figures given. The head and venational characters appear to indicate this position.

Synopsis of subfamilies.

- α^1 . Antennæ situated at upper angle of eyes (in facial view) or above this; lateral carinæ of vertex more or less distinct; ocelli always visible from above, on upper portion of lateral border, or on anterolateral portion of crown; eyes prominent; posterior border of pronotum more or less distinctly incurved.
- b^1 . Antennæ seated in deep transverse sharp-margined scrobes; face about as broad as long or broader; eyes small; vertex short half-ovate.
Macroceratogoniinæ.
- b^2 . Antennæ in shallow scrobes of ordinary type; face usually much longer than broad; vertex long; eyes large; tegmina without sub-apical cells, the veins of corium usually indistinguishable except by transmitted light..... Nirvaniinæ.
- α^2 . Antennæ situated at middle of eye margin (in facial view); lateral carinæ of vertex wanting; ocelli below anterior border of crown and not visible from above; head (from above) long spatulate, but not thin dorsoventrally; eyes not prominent, deep set in vertex; pronotum subtruncate posteriorly; tegmina with two subapical cells.

Stenometopiinæ.

MACROCERATOGONIINÆ

Synopsis of genera.

- α^1 . Body not depressed; pronotum narrowly rounded between eyes; crown narrow basally, broadly rounded apically, the margin not notched over antennal scrobe; eyes set in middle of lateral margins of face (facial view), large; antennal flagella longer than body; loræ very broad; clypeus broadened apically; proboscis of moderate length; subcostal cell of tegmina without supernumerary cross veins (Macroceratogoniini)..... Macroceratogonia Kirkaldy.
- α^2 . Body more or less depressed; pronotum subtruncate or very broadly rounded between eyes; crown broad basally, obtuse angled apically, margin deeply notched over antennal scrobe; eyes set below middle of face, small; antennal flagella very short; loræ narrow; clypeus narrowed apically; proboscis very short; subcostal area with a number of supernumerary cross veins (Balbillini).
- b^1 . Body but slightly depressed; tegmina not strongly narrowed apically, the subcostal area not greatly broadened, or with strongly curved outer margin; tegmina membranous, venation distinct throughout.
Balbillus Distant.
- b^2 . Body very strongly depressed; tegmina tectiform, strongly narrowed apically, the subcostal area expanded, and the outer margin strongly curved; tegmina subcoriaceous, venation obscure basally.

Stenotortor g. nov.

Genus **MACROCERATOGONIA** Kirkaldy

Kirkaldy, Bull. Hawaiian Sugar Planters' Assoc. 1 (1906) 323.

Type, *Macroceratogonia aurea* Kirkaldy (Queensland).

Genus *BALBILLUS* Distant

Distant, Fauna Brit. India, Rhynch. 4 (1908) 287.

Type, *Balbillus granulatus* Distant (Ceylon).

The known range of this well-marked genus is now extended to Singapore and to British North Borneo. The relationships of *Balbillus* and *Macroceratogonia* seem to be unquestionable.

Balbillus albellus sp. nov. Plate 3, fig. 21.

Very pale ochraceous, the scutellum darker ochraceous with the apex blackish. Tegmina and wings milky translucent, subcostal and apical areas of tegmina subhyaline; small fuscous clouds covering apex of clavus, and apices of apical veins. Length, female, 6.75 to 7 millimeters; male, 5.5.

Whole front, to sides and extreme base, strongly flattened, delicately shagreened, the strongly curved lateral sutures of front distinct to their basal union beneath apex of vertex (Plate 3, fig. 21, *c*); genæ strongly extended beyond clypeus. Eyes small, width between them and front on either side greater than their width in facial view; face about as broad as long. Antennæ situated close under the margin of crown, the scrobe cutting through next eye to the upper surface of crown. Anterior margin of crown bordered by a sharp carina which is equivalent to the subocellar carina of *Pythamus*; the true vertex (Plate 3, fig. 21, *a*) is margined anteriorly by a curved carina which touches the border carina only at apex and curves backward toward, but does not connect with, the lateral carinæ of vertex, the indistinct ocelli being situated just within anterior extremities of latter, thus anterior to eyes and three times their diameter from latter. Length of crown a little less than interocular width, the basal margin straight, the lateral margins in front of eyes deeply angularly incised over the antennæ; delicate vestiges of a median carina occur only at base and before apex; median basal area smooth, remainder of surface more or less wrinkled and roughened. Length of pronotum nearly as great as that of vertex, the anterolateral margins into width about three times; surface smooth, depressed back of eyes, median basal area thickly microscopically transversely aciculate and sparsely punctate. Scutellum a little longer than pronotum, median basal area smooth, apical area minutely roughened, and suddenly elevated just before extreme apex, clavus smooth, subcostal area of corium subobsoletely wrinkled and punctured, stronger basally. Venation peculiar because of

the very small first apical cell, the very long, narrow, and similar second and third apicals, and the very large fourth apical cell; subcostal area with some light cross veins on distal half, which are distinct only by transmitted light. Subgenital plate of female with a small semicircular emargination behind.

STRAITS SETTLEMENTS, Singapore (*Baker*). Common. Judging from the published description and figure, this is very distinct from *B. granulosis* Distant of Ceylon. A larger form (length, 7.5 millimeters) of this species occurs at Sandakan, British North Borneo, and this is here designated var. *borneensis*.

These insects may be covered with white waxy powder, which readily rubs off.

Genus *STENOTORTOR* novum

Type, *Stenotortor inocarpi* sp. nov.

Characters as given in the generic synopsis. This genus represents a more highly specialized *Balbillus*. While the life habits of *Balbillus* are not known, it is to be presumed, from the greatly flattened face, very short proboscis, and more or less tectiform tegmina, that in a state of rest on the leaf the body is strongly appressed to the leaf surface, as in *Stenotortor*. Some of the striking structural modifications of both genera are correlated with this curious habit.

Stenotortor inocarpi sp. nov. Plate 3, fig. 22.

Pale brick red throughout, the face paler, the vertex and pronotum inclining to ochraceous. A broad fuscous-clouded band extends from basal margin of clavus to two-thirds its length on inner half, a short median fuscous spot in radial area, and a fuscous band occupying most of medial area and extended laterally to claval suture; base of third apical cell clouded with fuscous. Length, female, 5 millimeters; male, 4.75.

Differs from *Balbillus albellus* in structure as follows: Face a little wider than long, eye a little wider than temple in facial view (Plate 3, fig. 22, *c*). The antennæ, although close up under border of crown, yet possess a short, distinct, separated supra-antennal carina, which is lacking in *B. albellus*. The apical border carina of the true vertex is as strong as the border carina of crown and connects with the lateral carinæ before ocelli (Plate 3, fig. 22, *a*), the latter a little farther removed from lateral carinæ; anterior half of vertex distinctly depressed, posterior half plane; median carina distinct throughout, stronger apically.

Pronotum also coarsely subobsoletely transversely wrinkled on posterior area (as also on basal area of scutellum); length less than that of vertex, the anterolateral margin into width about three and a half times. Venation (Plate 3, fig. 23) similar to that of *Balbillus albellus* but first (inner) apical cell larger, second and third apical cells distinctly broadened distad, and fourth strongly narrowed distad; marginal vein indistinct around apex. Hind margin of subgenital plate of female with a deep narrow median slit.

STRAITS SETTLEMENTS, Singapore (*Baker*). The year 1918 spent in Singapore as assistant director of gardens, in association with a wonderful observer in the person of the director, Mr. I. H. Burkill, brought to my attention a world of marvelous biological novelties. The unique lecaniids living inside of twigs of *Macaranga* under the care of ants, many astonishing cases of ant-plant associations (in one of the latter cases accompanied by a symbiotic brentid)—all of these and more can be studied to great advantage in the Botanic Gardens of Singapore. Not among the least of these interesting things do I count this beautiful little *Stenotortor*. In the economic gardens, near the office, stood a fine large introduced tree, *Inocarpus edulis*, of the Leguminosæ, the "Otaheite chestnut," supposed to have come from Polynesia. In passing beneath it from day to day, my attention was called to little red objects, tightly appressed to the surface of the leaves, and these I passed by for some time, supposing them to be scale insects affected by a red parasitic fungus, such affected scales being common in the gardens. One day, reaching up and touching one of them, I was astonished to see it leap quickly away. Closer examination revealed this unique jassoid insect. I do not know of any other adult jassid that can apply itself so closely to the leaf surface, although this habit is not uncommon among nymphs. The shade of its color is almost exactly that of the common scale fungus. It is thickly covered with brick red waxy powder which does not rub off easily. At rest on the leaf, the tegmina are much more widely, tectiformly outspread than in the mounted specimen. It will doubtless also be found on native Singapore Leguminosæ.

NIRVANIINÆ

Synopsis of genera.

- α^1 . Interocular portion of vertex never parallel sided; vertex broad, width between eyes greater than half width of pronotum, the latter never strongly narrowed cephalad; clypeus gradually a little narrowed to a broad subtruncate or slightly notched apex.

*b*¹. Sides of vertex strongly sinuate at middle of anteocular length; front with sides strongly incurved on basal half; lateral margins of front distant from the small eyes; brachypterous.

Didius Distant.²¹

*b*². Sides of vertex never strongly sinuate; front never with sides strongly incurved on basal half; lateral margins of front not far from the large eyes; all macropterous.

*c*¹. Ocelli distinctly nearer to each other than distance between eyes; medial cell strongly broadened apically, the sides never strongly incurved; vertex as long as, or usually shorter than, anteocular width..... *Kana* Distant.

*c*². Ocelli as far apart as distance between eyes (rarely a little less) or farther; medial cell usually strongly narrowed apically, the sides more or less incurved; vertex as long as, or usually somewhat longer than, anteocular width.

*d*¹. Front depressed only apically; face above full and evenly convex, the oblique lateral folds low, broad, and indistinct; basal portion of median frontal carina not strongly raised.. *Nirvana* Kirkaldy.

*d*². Front depressed throughout or largely so; the narrow upper portion with conspicuous sharp oblique lateral folds; basal portion of median frontal carina more or less sublaminate raised.

*e*¹. Upper portion of disk of front without a strongly raised delimiting carina; length of vertex rarely as great as one and a half times anteocular width; ocelli rarely partially visible in facial view.

*f*¹. Vertex with the bordering carina weak and low, sinuate or obsolete at position of ocelli, which are raised on the rounded lateral margin so as to be plainly visible in lateral view; outline of vertex subtriangular with more or less strongly curved sides, but narrowing cephalad from very near eyes.

Pseudonirvana g. nov.

*f*². Vertex with the bordering carina strongly, thinly extended and raised, making the disk of the vertex rather strongly concave and usually hiding the ocelli in lateral view; outline of vertex broadly elliptical, usually equally broad for some distance in front of eyes..... *Ophiuchus* Distant.

*e*². Upper portion of disk of front with a strongly raised and sharply delimiting carina; length of vertex more than twice anteocular width; ocelli clearly visible in facial view.

Nirvanoides g. nov.

*a*². Interocular portion of vertex with parallel sides; vertex narrow, width between eyes less than half width of pronotum, the latter strongly narrowly rounded anteriorly.

*b*¹. Vertex long, not broadened in front of eyes; clypeus suddenly narrowed to a rounded apex; loræ very short; face far longer than broad; head much narrower than pronotum; apical cells long and narrow, venation distinct throughout..... *Pythonirvana* g. nov.

*b*². Vertex short, broadened in front of eyes; clypeus very gradually narrowed to a subtruncate apex; loræ narrow, but long; face as long

²¹ *Didius* is provisionally placed in this subfamily.

as broad; head but slightly narrower than pronotum; apical cells short and strongly subtriangular; venation indistinct basally.

Jassonirvana g. nov.

Genus *KANA* Distant

Distant, Fauna Brit. India, Rhynch. 4 (1908) 285.

Type, *Kana thoracica* Distant (Ceylon).

Synopsis of species.

- a*¹. Apical cells long and narrow, subequal in length and width; tegmina with a median straight transverse finely dotted band and entire apical area (beyond cross veins) fuscous..... *K. illaborata* Distant.
- a*². Apical cells shorter, very unequal in size and shape.
 - b*¹. Tegminal margin more or less evenly rounded apically; third apical cell (from within) large, trapezoidal, larger than second; appendix very small and narrow, sometimes almost indistinguishable.
 - c*¹. Prevailing colors piceous and chestnut brown; frontal carina entirely wanting..... *K. picea* sp. nov.
 - c*². Prevailing colors pale ochraceous, with two black spots on apical area of tegmina; frontal carina present only on apical half of front..... *K. maculata* sp. nov.
 - b*². Tegmina strongly sinuately margined at apex, the fourth apical cell with a pronounced teatlike extension at apex; third apical cell small, parallel sided, much smaller than second; appendix ample, especially at inner apical angle of tegmina; frontal carina present only on apical half of front..... *K. anomala* sp. nov.

Kana illaborata Distant. Plate 3, figs. 24 and 25.

Distant, Fauna Brit. India, Rhynch. 4 (1908) 287.

Pale ochraceous; vertex and pronotum with irregular longitudinal stripes of white and yellow, on the vertex a median and two lateral white, two submedian yellow, on the pronotum a median, two submedian, and lateral margins white, and two submedian and two sublateral yellow; scutellum with basal median line, basal angles, and apical area pale yellow or whitish. Tegmina subhyaline, fuscous beyond apical cross veins, middle of corium and clavus crossed by a broad, straight, finely dotted pale fuscous band. Length of female, 6.5 millimeters.

Face (Plate 3, fig. 24, *c*) about as broad as long; entire disk of front flattened, the complete frontal carina at base suddenly broadened and coalescent with thickened upper margin of front. Front and clypeus basally shagreened, genæ sparsely punctate below eyes, irregularly rugose apically; supra-antennal carina sharp, passing obliquely straight to upper margin of eyes; the usual upper lateral ridges of face below border of vertex sharply carinate, one stronger than the rest extending above the supra-antennal carina, toward upper lateral angles. Crown (Plate 3,

fig. 24, a) somewhat longer than width between eyes, the lateral margins in front of eyes straight for a short distance; anterior border margined by a sharp carina—the subocellar carina of *Pythamus*; the ocelli are thus on the upper surface of the flat crown though subtended mesad by a delicate subobsolete sinuous carina which represents the supraocellar carina of *Pythamus*; ocelli nearly four times as far from each other as from lateral borders of crown and distinctly in front of anterior line of eyes; just within the anterior margin of crown is a sharp, narrow, concentric depression, giving the anterior margin somewhat the appearance of being reflexed; median carina sharp and complete, but less strong anteriorly; surface of vertex smooth. Length of vertex a little more than interocular width. Pronotum a fifth shorter than vertex, the anterolateral margins into width a little less than five times; hind border slightly incurved; a broad median area very finely thickly transversely aciculate, the remainder of surface smooth. Subgenital plate broadly obtuse-angularly extended at middle. Venation (Plate 3, fig. 25, a) of tegmina peculiar because of the very large and long apical cells of similar length, the second and fourth larger and of subequal breadth; appendix inconspicuous; venation of wing as in Plate 3, fig. 25, b.

BORNEO, Sandakan (*Baker*). STRAITS SETTLEMENTS, Singapore (*Baker*). This appears to be nothing more than a form of the species described by Distant from Tenasserim. It is common in North Borneo.

Kana picea sp. nov. Plate 3, fig. 26.

Black and piceous, shining; legs, anterior margin of crown, and abdomen except segmental margins pale ochraceous; scutellum, and clavus except two oblique black spots on inner margin at middle and extreme apex, chestnut brown. Tegmina piceous to apical cross veins except a small chestnut brown spot in cubital area at two-thirds its length, and a large subhyaline triangular area next outer margin apically, the inner point of this triangle reaching into radial cell, from this two oblique piceous stripes extending to apical margin; the margins of the subhyaline area, and the apical cross veins yellowish to reddish. Extremities of hind tibiae and of first tarsal joint black. Length, female, 5 millimeters; male, 4.

Differs from *K. illaborata* in structure as follows: Face (Plate 3, fig. 26, c) a fourth broader than long; front similarly flattened but entirely without a median carina, whole surface very finely

thickly rugulose; clypeus shagreened medially near base, the lateral depressed areas extending nearly to base. Sculpture of face laterally at base very similar to that of *K. illaborata*, but the head beyond eyes much slenderer in side view. Crown (Plate 3, fig. 26, *a*) a fourth longer than width between eyes, the lateral margins of head suddenly prominent just beyond eyes; vestiges of supraocellar carina absent; median line shallowly incised, the median carina a fine line at bottom of incisure on basal half; whole surface of vertex slightly depressed but each lateral area gently convex, basal half nearly smooth except for a few scattering punctures, apical half coarsely shagreened and medially with minute longitudinal wrinkles; ocelli more than twelve times as far from each other as from lateral carina of vertex and much nearer this lateral carina than to eye. Pronotum on posterior two-thirds subobsoletely transversely wrinkled, anteriorly with two small submedian oval depressions; the length nearly two-thirds that of vertex, the anterolateral margins into width somewhat less than five times. Scutellum indistinctly irregularly wrinkled except at basal angles and with an indistinct median carina on basal area. Clavus and base of corium with scattering punctures from which arise minute white hairs stronger than usual. Venation (Plate 3, fig. 26, *d*) similar to that of *K. illaborata*, but the apical cells shorter. The male differs in being very much smaller, with the crown somewhat shorter and less strongly rounded anteriorly.

LUZON, Benguet Subprovince, Baguio (*Baker*). This beautiful species is closely related to other species of *Kana* in essential characters, but differs sharply in certain details of sculpture and in the absence of frontal carina.

Kana maculata sp. nov. Plate 3, fig. 27.

Pale ochraceous, lateral margins of pronotum broadly yellowish; a fuscous band extends from anal margin of clavus, straight in line of long axis of tegmina, across clavus, and terminates in corium near apex of medial area; apices of radial and medial areas reddish; from apex of radial area three narrow fuscous stripes extend outward and proximad to costal margin; three inner apical cells largely yellowish; a black spot at apex of outer apical cell, another smaller one on the inner apical vein. A small black spot on the lateral surfaces of the pygofers. Length of female, 5.5 millimeters.

Differs from *K. illaborata* in structure as follows: Frontal carina recognizable only on anterior half of front. Lateral mar-

gins of head in dorsal view angulately prominent in front of eyes. Vertex nearly as in *K. picea*; length less than width. Pronotum (Plate 3, fig. 27, a) four-fifths the length of vertex, the anterolateral margin unusually long, into the width four times; the surface entirely smooth except for a few scattered punctures on basal area. Scutellum very minutely roughened. Venation similar to that of *K. picea*, but apex of tegmina and apical cells of different form (Plate 3, fig. 27, b). Subgenital plate medially deeply roundly emarginate.

LUZON, Laguna Province, Mount Maquiling (*Baker*). A conspicuous but apparently rare species from the forest.

Kana anomala sp. nov. Plate 3, fig. 28.

Pale ochraceous; the vertex margined at sides and in front with a white waxy band, within this a reddish band; pronotum, scutellum, and a large part of tegmina pale reddish brown; entire subcostal area broadly albescent, this having a straight transverse fuscous stripe at its apex and four equally spaced oblique fuscous stripes crossing its field, the first being near to base; the outer cross vein is bordered with red, and a small yellow spot occurs on the fourth oblique fuscous stripe; broad longitudinal vermiculately fuscous bands extend, one along inner two-thirds of clavus, and one along middle of corium, these connecting apically where they form a broader median patch; apex of clavus and small dots at bases of two inner apical cells black; small albescent patches occur before the three inner apical cells and in apical area of clavus; the teatlike extension of outer apical angle of tegmina and a large patch at inner apical angle fuscous. Apex of first hind tarsal joint and a spot on the lateral face of each pygofer black. Length, female, 6.75 millimeters; male, 4.5.

In the male, which presents the usual difference in form of head, the longitudinal vermiculately fuscous bands of tegmina are wanting, the area of reddish brown thus being greater; the first (basal) oblique stripe in subcostal area is wanting, and the black and albescent markings near bases of apical cells are wanting.

Differs from *K. maculata* in structure as follows: Vertex more as in *K. illaborata*, the surface not at all incised at median line, the median carina distinct on basal half; length of vertex (Plate 3, fig. 28, a) a little greater than width between eyes; ocelli situated nearly as in *K. picea*. Pronotum nearly smooth throughout, but with faint, minute indications, medially, of

transverse wrinkles; the length is three-fourths that of vertex, the anterolateral margin into width somewhat more than four times; the hind margin broadly incurved. Tegmina with a teat-like extension of the exterior apical angle very strongly marked in the female (Plate 3, fig. 28, *b*), less so in the male; appendix apically broad and conspicuous as compared with the narrow and inconspicuous appendices of other species. Subgenital plate with hind margin subtruncate, slightly bisinuate.

LUZON, Laguna Province, Mount Maquiling (*Baker*). The most beautifully marked of the species herein treated and remarkable for the highly developed and unique sexual differences. It will be noted that the sexual differences here are much more profound in both structure and coloration than are given by Distant to separate the "species" *K. thoracica* from *K. ramificata* and *K. illuminata* from *K. signata*, for which are given no sexual or structural characters not within the bounds of sexual differences usual in this genus.

Genus NIRVANA Kirkaldy

Kirkaldy, The Entom. 33 (1910) 293.

Type, *Nirvana pseudommatus* Kirkaldy (Ceylon).

Without a careful study of the type species, which I do not possess, it is impossible to be certain of the limits and position of this genus. The description of Kirkaldy is entirely inadequate, as to both genus and species, to distinguish it certainly among the great number of Oriental forms, without specimens for comparison. Melichar, in working up the Homoptera of Ceylon, did not have Kirkaldy's species but considered *N. pallida* Melichar as certainly congeneric and amended the generic description from that species. Two Far Eastern species, *N. philippinensis* sp. nov. and *N. placida* Stål, are certainly congeneric with *pallida* (indeed, *pallida* is probably synonymous with *placida*), so that I have taken these two species as typical of true *Nirvana*. They agree fairly with descriptions and with Melichar's figures. *Nirvana suturalis* Melichar is doubtfully congeneric, as is also *N. insignis* Distant. *Nirvana decora* Melichar may be a *Kana*. Three of Distant's species, *N. greeni*, *N. longitudinalis*, and *N. linealis*, appear to belong to *Pseudonirvana*; the second certainly does.

Synopsis of species.

- ♂. Tegmina with a small fuscous dot at base of second apical cell; costal area with two oblique fuscous stripes; vertex and pronotum with a

- broad median ivory white line; vertex largely thickly finely longitudinally wrinkled *N. placida* Stål.
a°. Tegmina with a large round deeply black spot at base of second apical cell; costal area with three oblique fuscous stripes; vertex and pronotum with a fine median black line; vertex largely smooth, sparsely wrinkled anteriorly..... *N. philippinensis* sp. nov.

Nirvana placida Stål. Plate 4, figs. 29 and 30.

Stål, Freg. Eng. resa Ins. (1859) 295 (*Jassus* sub *Deltocephalus*).

It was with no little pleasure that I collected in Singapore and Penang large series of this species, described by Stål in 1859 and unrecognized since. Stål recorded it from Singapore and Hongkong, and I have it also from Sandakan, North Borneo. Specimens received from Matsumura, collected in Formosa, and bearing the name *Nirvana pallida* Melichar are the same species. Matsumura also records it from Riu Kiu.³² It appears to be actually *N. pallida* Melichar, so far as can be judged from descriptions and figures, though careful comparison should be made with Ceylonese specimens. This species shows a strong sexual dimorphism in the head (Plate 4, figs. 29 and 30), though the tegmina in the two sexes are practically identical.

The structure of this species is very similar to that described below for *N. philippinensis*. Only the median basal portion of vertex is smooth, the rest of the surface being occupied by thick fine longitudinal wrinkling. The pronotum and scutellum are smoother. The vertex in the male (Plate 4, fig. 30, *a*) is a little shorter and more acute than in the female (Plate 4, fig. 29, *a*). In a male tegmen (Plate 4, fig. 30, *b*) the two oblique cross veins in subcostal area are distinct; in a female tegmen (Plate 4, fig. 29, *d*) these are quite indistinguishable.

Nirvana philippinensis sp. nov. Plate 4, fig. 31.

Very pale ochraceous; the delicate complete median carina of vertex is black, and a median stripe a little paler in color continues across the pronotum and scutellum, and in some specimens the full length of claval commissure; ocellus seated in an orange spot. Tegmina milky translucent, three oblique fuscous stripes over the corresponding cross veins in apical half of subcostal area; a large orange spot covers apical portions of radial and medial areas; apical submargin fuscous, this extending into outer apical cell; a large round black spot at base of second apical cell; extreme apex of clavus fuscous. Length, female, 5 millimeters; male, 4.25.

³² Trans. Sapporo Nat. Hist. Soc. 1 (1905) 21.

Face finely shagreened, the front rather strongly evenly convex and with a fine complete median carina. Basal lateral area of face sculptured as in *Kana illaborata*. Vertex (Plate 4, fig. 31, *a*) about one and a half times as long as wide between eyes, the curve of lateral margin of head even from the eyes to the subangulate apex. Ocellus on the rounded curved anterior border passing to the front, about four times its diameter from eye; the sharp fine carina bordering anterior margin of vertex becomes weak near ocellus, passes above it and is lost in the callose lateral margin of vertex adjoining eye; there is a distinct subocellar carina just below the ocellus which joins and is continuous with the supraocellar carina some distance beyond ocellus; the condition is, therefore, comparable with that in *Pythamus*. Surface of vertex slightly depressed, gently convex, basal two-thirds smooth, apical third sparsely weakly longitudinally wrinkled, the raised callose lateral margins next to eyes rugose. Pronotum two-thirds length of vertex, the anterolateral margins into width somewhat more than three times; basal two-thirds subobsoletely transversely wrinkled and sparsely punctate. Scutellum minutely rugose except the shagreened basal angles. Apical cells in tegmina distinctly larger than in *N. placida*.

LUZON, Laguna Province, Los Baños and Mount Maquiling (*Baker*). MINDANAO, Surigao Province, Surigao: Lanao Province, Kolambugan: Zamboanga Province, Dapitan (*Baker*). This very abundant species is remarkably uniform in characters throughout the lowlands. At Baguio, Benguet, Luzon, in the high mountains, it differs by having the claval commissure broadly black and the orange at apex of radical and medial areas extending more or less toward the costa between the oblique fuscous stripes. This form is designated var. *montana*.

Genus PSEUDONIRVANA novum

Type, *Pseudonirvana sandakanensis* sp. nov.

Characters as given in the synopsis of genera. This genus includes a number of species formerly referred to *Nirvana*, as remarked under that genus. It appears to be richer in species than any other genus of the family and to be distributed throughout the Indo-Malayan countries.

Synopsis of species.

- α*¹. Ocelli very large and prominent; second and third apical cells subequal in length and parallel sided, their basal cross veins in line or nearly so; tegmina largely reddish yellow, with three long oblique stripes

in subcostal area and a large dark fuscous cloud over third apical cell; vertex nearly smooth..... *P. ocellaris* sp. nov.

a². Ocelli medium to small; second and third apical cells not subequal in length and parallel sided, their basal cross veins usually strongly dislocated.

b¹. Median carina strikingly different on anterior and posterior halves of vertex; outer apical vein in tegmina strongly curved or sinuate; vertex and tegmina apically without large black spot.

c¹. Tegmina long and slender; outer apical vein strongly outcurved; second apical cell with subparallel sides; head distinctly narrower than pronotum, two oblique subcostal stripes; median carina of vertex strong on anterior half, on basal half appearing as a fine line set in an incisure; vertex in large part with wrinkled surface.

P. penangensis sp. nov.

c². Tegmina rather short and broad; outer apical vein strongly bisinuate; second apical cell strongly broadened apically; head nearly as broad as pronotum; three oblique subcostal stripes; median carina of vertex obsolete on anterior half; vertex in large part smooth..... *P. singaporensis* sp. nov.

b². Median carina of vertex complete and equally strong throughout.

c³. Vertex nearly smooth except for a few indistinct wrinkles.

d¹. Outer apical vein very strongly curved; head and tegmina apically without large round black spots; vertex with a median yellowish line; anterolateral margin of pronotum much longer than posterolateral..... *P. malayana* sp. nov.

d². Outer apical vein straight or nearly so; with a large round black spot near apex of tegmina; anterolateral and posterolateral margins of pronotum subequal.

e¹. Vertex with an apical black spot; apex of tegmina evenly rounded; first apical cell long and narrow.

P. sandakanensis sp. nov.

e². Vertex with a subapical transverse sanguineous band bent caudad at sides; apex of tegmina somewhat emarginate beyond first and second apical cells (? in male); first apical cell very broad..... *P. sanguineolineata* sp. nov.

c³. Vertex in large part strongly conspicuously longitudinally wrinkled; anterolateral margins of pronotum much longer than posterolateral.

d³. Black spot of vertex apical, preceded by a single median dark line; vertex narrow, sides of head outcurved beyond eyes; first apical cell long, second very large and broad, third very small.

P. davaoensis sp. nov.

d⁴. Black spot of vertex subapical, preceded by two submedian black lines; vertex broad, side of head not outcurved beyond eyes; first apical cell short, second small and narrow, third very large.

P. longitudinalis Distant.

Pseudonirvana ocellaris sp. nov. Plate 4, fig. 32.

Very pale ochraceous; a small short transverse mark just before apex of vertex and anterior half of median carina reddish; sides of vertex and basal median area of pronotum clouded

with orange yellow; median basal area of scutellum lemon yellow. Tegmina with subcostal and apical areas hyaline, remainder orange yellow tinged with reddish apically; three oblique stripes in subcostal area and a costal dot distad of these fuscous; inner apical angle of second apical cell, nearly all of third, and apex of outer apical cell dark fuscous, this colored field very much darker basally. Length of male, 5 millimeters.

Front broadly flattened to extreme base, the sides not convexly rounded, and with a strong median carina which is a little raised near base; surface shagreened. Basal lateral areas of face nearly as in *P. malayana*. The very large and prominent ocellus lies close to inner extremity of bordering carina and a little more than its own diameter from eye. Length of vertex one and a half times interocular width, the inner margins of eyes strongly convergent caudad, sides of head protuberant in front of eyes; surface of vertex gently broadly concave, smooth except for scattering punctures, lateral folds minutely rugose. Length of pronotum (Plate 4, fig. 32, *a*) a little more than half that of vertex, the anterolateral margins into width about five times; surface appearing smooth but basal area very minutely transversely aciculate. Basal area of scutellum smooth. Venation (Plate 4, fig. 32, *b*) peculiar because of the position of the two oblique veins in subcostal area, these being farther than usual from apical cross veins; the subequal second and third apical cells with subparallel sides, and the cross veins at their base more or less nearly in line.

BORNEO, Sandakan (*Baker*). Remarkably distinct by the ocelli and the coloration.

Pseudonirvana penangensis sp. nov. Plate 4, fig. 33.

Very pale ochraceous, entirely without black markings; a small cloud before apex of vertex, and anterior half of median carina reddish. Tegmina subhyaline, inner half and apical veins tinted with yellowish; two faint oblique lines on apical half of subcostal area. Length of male, 5 millimeters.

Differs in structure from *P. davaoensis* as follows: Basal areas of sides of face as in *P. sandakanensis*; depression of front falling considerably short of reaching base of face. Ocellus situated in a small depression almost in line of bordering carina of vertex, and its own diameter from eye, the bordering carina becoming indistinct, about once the diameter of the ocellus before it, and sending indistinct branches both below and above it. Length of vertex (Plate 4, fig. 33, *a*) about one

and two-thirds times width between eyes; surface evenly gradually depressed, the basal half of median carina set in a shallow incisure; median basal area smooth with a few punctures, the remaining area thickly finely longitudinally wrinkled. Length of pronotum about half length of vertex, anterolateral margin into width about four times. Venation (Plate 4, fig. 33, *b*) peculiar because of the long narrow parallel-sided second apical cell, and the strongly outcurved third apical vein, in this resembling *P. ocellaris*.

STRAITS SETTLEMENTS, Penang Island (*Baker*).

Pseudonirvana singaporensis sp. nov. Plate 4, fig. 34.

Very pale ochraceous throughout, with no black markings. Tegmina hyaline, with the usual three transverse fuscous stripes in subcostal area, but in this case very faint. Length of female, 6 millimeters.

Differs from *P. penangensis* in structure as follows: Frontal depression reaching nearly to extreme base of face. Ocellus small, twice its diameter from eye, situated in a depression distinctly behind the bordering carina of front and behind the thickened margin, the bordering carina anterior to ocellus being lost in numerous fine wrinkles, and about apex of vertex very weak. Vertex (Plate 4, fig. 34, *a*) large and broad, length nearly one and a half times the interocular width, the width of the whole head being nearly that of pronotum; anterior half of median carina of vertex obsolete, posterior half finer and set in a shallow incisure; surface evenly depressed, smooth except narrowly before apical margin where it is indistinctly longitudinally wrinkled. Length of pronotum half that of vertex, the anterolateral margins into width about six times. Venation (Plate 4, fig. 34, *b*) peculiar because of the long trapezoidal second apical cell, and the strongly sinuate outer apical vein.

STRAITS SETTLEMENTS, Singapore (*Baker*). This cannot be the other sex of *P. penangensis* due to the widely different structure, although they are somewhat superficially similar in entirely lacking strong color markings.

Pseudonirvana malayana sp. nov. Plate 4, fig. 35.

Very pale ochraceous; face medially ochraceous, margins whitish; apical submargin of vertex with a blood red transverse line; side margins of vertex and apical half of median line washed with yellowish; lateral areas of vertex divided medially by a broad longitudinal ivory white band (the two diverging

cephalad), the latter continued across pronotum and on to scutellum. Tegmina hyaline, with the usual three fuscous stripes in subcostal area, the space between the second and third of these and the apical veins more or less yellow. Length, female, 6 millimeters; male, 5.

Basal lateral areas of face about as in *P. longitudinalis*, with the remarkable difference that the carinate wrinkle, which passes obliquely upward to subtend the ocellus in that species, here joins the bordering carina of vertex, the ocellus lying above the bordering carina, the latter beyond this point and toward the eye being lost in many fine longitudinal wrinkles; the ocellus is small and more than its own diameter distant from the eye. The length of vertex (Plate 4, fig. 35, *a*) is one and a half times the interocular width; median carina on basal third fine and set in an incisure; surface broadly slightly depressed, largely smooth, indistinctly wrinkled or rugose near apical margin and in basal angles. Median basal area of scutellum smooth. Venation (Plate 4, fig. 35, *b*) peculiar in the distally narrowed second apical cell and in the strongly outcurved third apical vein.

BORNEO, Sandakan (*Baker*). STRAITS SETTLEMENTS, Penang Island and Singapore (*Baker*). In coloration of head and pronotum this common Malayan species resembles *P. sanguineolineata*, and in venation, *P. penangensis*, but is distinct otherwise. As usual, the head of the male is a little shorter and more pointed. Three males from Penang (normal males are common there) have the whole upper surface strongly suffused with golden yellow, and this form is designated var. *auricolor*.

Pseudonirvana sandakanensis sp. nov. Plate 4, fig. 36.

Very pale ochraceous; a small apical cloud on vertex and anterior half of median carina reddish or blackish. Tegmina subhyaline, an irregular faintly orange cloudy band extending transversely from apex of clavus to costa; three fuscous stripes in subcostal area in usual position, the first faintest; a large round black spot lying half in second apical cell and half in third. Length of female, 4.25 millimeters.

Differs from *P. davaoensis* in structure as follows; Median frontal carina a little raised basally. Sculpture of basal lateral areas of face similar to that of *Kana illaborata* instead of *Pythamus*. Ocellus situated above the carina which actually borders anterior margin of crown, but a short branch of this carina passes to inner border of ocellus. Length of vertex (Plate 4, fig. 36, *a*) about one and a half times interocular width, the

vertex and pronotum as a whole much broader in proportion to width than in *P. davaoensis*; median carina equally strong throughout but not quite reaching apex of vertex; lateral areas strongly depressed, especially basally; surface smooth, with few scattering punctures. Pronotum half the length of vertex, anterolateral margins into width a little more than six times; hind margin broadly subangularly emarginated. Venation (Plate 4, fig. 36, b) peculiar in the small and apically narrowed second apical cell.

BORNEO, Sandakan (Baker). This small species is a conspicuous case of a common condition in this family, of species so closely resembling others in colors that they might be placed together on superficial examination, and yet be totally distinct structurally.

Pseudonirvana davaoensis sp. nov. Plate 4, fig. 37.

Very pale ochraceous; a large black spot at apex of vertex; sides of head in front of eyes slightly yellowish. Tegmina clear hyaline; three fuscous subcostal stripes in the usual position of the cross veins, the first faintest; a large round black spot entirely within the large second apical cell. Length of female, 4.5 millimeters.

Disk of front plane, sides roundly convex, surface coarsely shagreened, the fine central carina weaker at the middle, stronger above where it is not raised. Ocellus visible in either dorsal or facial view, on the lateral border of head and beneath the continuous strong supraocellar carina, which borders the entire margin of vertex; a subocellar carina extends strongly obliquely downward from apex of front as in *Pythamus*; the ocellar area is narrow and has several transverse wrinkles within; the upper lateral carina of front passes from near end of supra-antennal carina obliquely upward and toward apex; supra-antennal area smooth. Vertex (Plate 4, fig. 37, a) twice as long as interocular width, the lateral margin of head a little outcurved before eyes; the fine median carina complete, slightly stronger basally; the surface not depressed medially, little depressed along lateral margins, basal half smooth, with scattering minute punctures, apical half minutely irregularly wrinkled. Pronotum a little less than half length of vertex, anterolateral margins into width a little less than three and a half times, the anterolateral margins much longer than posterolateral; with or without a delicate median dark line; surface smooth except for subobsolete wrinkles on median basal area

and a few scattering minute punctures; hind margin shallowly subangularly emarginate. Basal area of scutellum smooth. Venation (Plate 4, fig. 37, c) peculiar in the very large second apical cell and subtriangular third.

MINDANAO, Davao Province, Davao (*Baker*). A single specimen from Mount Maquiling, Laguna Province, Luzon, agrees with the Davao specimens in all structural and color characters except that the vertex and pronotum are white waxy; the tegmina are opaquely albescent, with an orange-colored patch at apex of radial and medial areas, and the space between second and third subcostal stripes is fuscous. This form is here distinguished as var. *luzonensis*.

Pseudonirvana sanguineolineata sp. nov. Plate 4, fig. 38.

Very pale ochraceous; vertex apically with a submarginal arcuate violet stripe, which reaches the lateral margins and thence extends narrowly caudad to become lost in the lateral longitudinal orange stripes of vertex; median carina violet; two ivory white submedian longitudinal stripes become slender in diverging cephalad. Pronotum and scutellum with two submedian ivory white longitudinal stripes, these more or less diffuse on scutellum. Tegmina subhyaline; an irregular orange area occurs in the apices of radial and medial areas; from the incurved outer margin of radial area three cross veins extend to costal margin, the first two oblique, the last transverse and these and the outer apical vein are more or less clouded with fuscous; a large round black spot nearly fills the second apical cell and extends into the third. Wings albescent, strongly iridescent apically. Length of female, 5.25 millimeters.

Front plane, coarsely shagreened, the median carina fine, subobsolete at middle, more distinct basally where it is strongly raised. Sculpture of basal lateral areas of face similar to that of *Kana illaborata*. Ocellus on the lateral rounded border of vertex and turned outward, the sharper carina bordering crown anteriorly passing below it, a very short branch of this from in front of ocellus reaching its posterior border. Length of vertex (Plate 4, fig. 38, a) about one and three-fourths times the width between eyes; lateral margins of head before eyes gradually converging cephalad to a broadly rounded apex; surface a little depressed, nearly plane, indistinctly shagreened, the rounded lateral margins rugose, before apex with a few very fine and indistinct longitudinal wrinkles; the median carina does not quite reach the apex. Pronotum about half the length of

vertex, the anterolateral margins scarcely longer than posterolateral and into width about five times; the surface smooth and shining, the basal area with subobsolete transverse wrinkles and a few widely separated punctures. Scutellum with median basal area subobsoletely transversely wrinkled and apical area subobsoletely rugose. Venation as shown in Plate 4, fig. 38, *b*; the first oblique cross vein may be indistinguishable; extreme apex of tegmina shallowly emarginate, though this will probably prove to be less well marked in the male.

BORNEO, Sandakan (*Baker*). PALAWAN, Puerto Princesa (*Baker*). The Palawan specimens are specifically identical with those from Borneo.

Pseudonirvana longitudinalis Distant. Plate 4, fig. 39.

Distant, Fauna Brit. India, Rhynch. 4 (1908) (*Nirvana*).

This species is described from Tenasserim. Later, in the same work,³³ it is recorded from Burma. Through recent collections, we can extend its known range through Penang and Singapore to Sandakan and also to Hongkong.

The depth of coloring varies, but the markings are the same in all specimens. The face shows a strong similarity to that of *P. singaporensis*. Structures near the ocellus are peculiar; the oblique wrinkles of basal lateral portions of face are few and very strong, carinalike; from among them a strong carina passes toward upper margin of eyes and closely subtends the ocellus below; this carina is parallel to the supra-antennal carina, leaving between them a smooth narrow channel; border carina of vertex becoming subobsolete a short distance before ocellus, sending delicate branches above and below it; the ocellus lies in the line of the bordering carina and about its own diameter from eye. Length of vertex (Plate 4, fig. 39, *a*) about one and a half times interocular width; the anterior black spot may be emarginate apically; surface subdepressed apically, elsewhere gently convex, smooth medially on basal area, the remaining surface thickly longitudinally or obliquely wrinkled. Length of pronotum about two-thirds the length of vertex, anterolateral margins distinctly longer than posterolateral, and into width about three and a half times; surface sculptured as in other members of this group. Venation (Plate 4, fig. 39, *b*) peculiar in the narrow and somewhat curved second apical cell and the very large third apical cell.

³³ Op. cit. 7 (1918) 33.

Genus *OPHIUCHUS* Distant

Distant, Fauna Brit. India, Rhynch. 7 (1918) 33.

Type, *Ophiuchus princeps* Distant (Travancore).

There is nothing given in the generic descriptions of Distant by which the many species of the Nirvaniidæ can possibly be separated into generic groups. There is every gradation in size of vertex and in curve of outer margin. I have, therefore, selected from my material two new species which seem to be congeneric with *O. princeps* Distant, and have distinguished this group of species as stated in the synopsis of genera. These two species possess a type of venation which distinguishes them from all other known members of this family. But Distant does not describe the venation or show it in his figure. A third new species (*O. marginatus*) is doubtfully placed in this genus. Nothing more than this can be done until the type species is redescribed and its details are figured.

Synopsis of species.

- α^1 . Two apical cross veins nearly in line transversely, the two subcostal cross veins joining radial vein far proximad of apical cells.
- b^1 . Anterolateral margins of pronotum but slightly longer than posterolateral; a large blood red subapical spot in tegmina, the two subcostal oblique stripes subparallel..... *O. basilanus* sp. nov.
- b^2 . Anterolateral margins of pronotum about three times the length of posterolateral; vertex broadly margined laterally with red, these stripes passing caudad over pronotum and scutellum and following the commissural margins to end of clavus; the two subcostal oblique stripes converging mesad..... *O. montanus* sp. nov.
- α^2 . Two apical cross veins distinctly dislocated; two subcostal cross veins joining radial vein near apical cell..... *O. marginatus* sp. nov.

Ophiuchus basilanus sp. nov. Plate 5, fig. 40.

Pale ochraceous; bordering carina of vertex and anterior two-thirds of median carina black; sides of vertex broadly reddish yellow; pronotum and tegmina (the latter subhyaline) suffused with pale clear golden yellow. Pronotum with a median fuscous line. Tegmina with the subcostal area apically clear hyaline and crossed by two oblique fuscous stripes; a roundish blood red patch lying half in basal portion of second and half in basal portion of third apical cell. Length of male, 6 millimeters.

Front strongly flattened to extreme base, the fine median carina there suddenly stronger, the head as a whole (Plate 5, fig. 40, *b*) vertically very thin. Supra-antennal carina strongly

sharply elevated, the entire area between this and bordering carina of vertex nearly smooth, the frontal folds scarcely invading it. The very small ocellus lies just within the border carina of vertex, its own diameter distant from this carina, and some four times its diameter from eye. Length of vertex (Plate 5, fig. 40, *a*) little more than one and a half times interocular width, its surface plane anteriorly, depressed at sides basally, median basal area smooth, remainder finely longitudinally wrinkled. Length of pronotum into that of vertex two and a fourth times, the anterolateral margins much longer than posterolateral and into width a little less than four times; surface nearly smooth, with a few widely scattered punctures; hind margin broadly subangularly emarginate. Median basal area of scutellum nearly smooth. Tegmina subacutely pointed at apex of third apical cell, the second apical cell strongly narrowed distad, the third very large, the two cross veins in subcostal area far removed from apical cell, the two apical cross veins nearly in line. Head nearly as wide as pronotum.

BASILAN (*Baker*).

Ophiuchus montanus sp. nov. Plate 5, fig. 41.

Pale ochraceous, border carina and median carina of vertex brownish; vertex with slender submarginal reddish stripes. Pronotum with a fuscous median line and two broad submedian longitudinal reddish bands which extend across basal angles of scutellum. Tegmina subhyaline, the veins ochraceous, the two cross veins in subcostal area slightly darkened; anal margins and commissural margins of clavus broadly red, these bands extending obliquely from apex of clavus to apex of medial area. Length of male, 6 millimeters.

Differs from *O. basilanus* in structure as follows: The ocellus larger, its own diameter distant from border of crown, and about thrice its diameter from eye. Length of vertex (Plate 5, fig. 41, *a*) one and a third times the interocular width, its entire area evenly shallowly depressed, smooth only medially at extreme base, entire remainder of surface finely longitudinally obliquely rugosely wrinkled. Length of pronotum into that of vertex one and a half times, anterolateral margins far longer than posterolateral and into width a little more than three times; posterior two-thirds of surface densely very finely transversely aciculate, with a few scattering punctures at sides.

LUZON, Laguna Province, summit of Mount Maquiling (*Baker*).

Ophiuchus marginatus sp. nov. Plate 5, fig. 42.

Pale ochraceous; vertex with an arcuate violet mark just before apex, the median line and lateral margins to apex broadly reddish. Pronotum with a median band basally, and broad submedian longitudinal bands, reddish, the latter extending across basal angles of scutellum. Tegmina hyaline, basal area clouded with pale golden yellow, basal and commissural margins of clavus broadly reddish. Length, 6.5 millimeters.

Differs from *O. basilanus* in structure as follows: Supra-antennal carina not so strongly raised, the space between it and border of carina broader, and traversed medially by a slender carinate wrinkle. While the general outline of the head is similar to that in other species, the course of the border carina and the accompanying structures are entirely different; the border carina curves inward before ocellus and has lying within it a delicate sinuate carina which passes mesad of the ocellus; the ocellus is less than its own diameter from either of these carinae and about three times its diameter from eye. Length of vertex (Plate 5, fig. 42, *a*) a little less than one and a third times the interocular width; surface nearly plane and entirely smooth except for a few indistinct longitudinal wrinkles before apex. Tegmina (Plate 5, fig. 42, *c*) more broadly rounded apically, the outer apical vein strongly curved, the two cross veins in subcostal area lying close to apical cell, and the two apical cross veins strongly dislocated.

STRAITS SETTLEMENTS, Singapore (*Baker*). This species differs so widely from the two preceding species that it is placed in *Ophiuchus* with some doubt. The structure of the vertex is unique, and the venation is very different in detail from that of the other species.

Genus NIRVANOIDES novum

Type, *Nirvanoides amboinensis* sp. nov.

Characters as stated in the generic synopsis. This genus represents an extreme development of the *Nirvana* type of jassoid insects, similar to the African *Atritona* Melichar as to length of head, though in that genus the outline of apex of head is very obtuse, almost truncate.

Nirvanoides amboinensis sp. nov. Plate 5, fig. 43.

Very pale ochraceous; vertex with a black point at apex, and from this extend caudad two delicate submedian black lines, widest apart on anterior half of vertex and gradually converg-

ing caudad to the transverse furrow of scutellum. Tegmina translucent, subcostal area hyaline and apically with two widely separated pale fuscous oblique stripes, the second near to apex. Length, female, 6.5 millimeters; male, 5.25.

Front strongly flattened to extreme base and nearly to lateral margins, the narrow sides convexly rounded; the delicate median carina is stronger and considerably raised at base. Basal lateral areas of face somewhat as in *Pseudonirvana longitudinalis*, but the supra-antennal area broader; the minute ocellus is situated beneath the bordering carina and about four times its diameter from eye; the bordering carina is weak just before ocellus and becomes obsolete behind it where it is lost in the minute wrinkles on lateral fold of vertex. Length of vertex (Plate 5, fig. 43, *a*) two and a half times interocular width; surface evenly gently concave, smooth except for scattering punctures, and usually white waxy pulverulent. Length of pronotum equaling interocular width, anterolateral margins far longer than posterolateral, and into width little more than two and a half times; anterior margin unusually broadly rounded. Scutellum very large, longer than pronotum, the median basal area smooth. Venation (Plate 5, fig. 43, *d*) peculiar because of the very large and long second apical cell, which is narrowed apically, and the small, short third apical, which is strongly broadened apically; in the male (Plate 5, fig. 43, *c*) one cross vein in subcostal area may be quite distinct, while in the female both cross veins may be indistinguishable. Subgenital plate of female with hind margin truncate as in most species of this family.

AMBOINA (*Muir*). During his Moluccan travels, Mr. Muir found this species only on Amboina.

Genus PYTHONIRVANA novum

Type, *Pythonirvana muiri* sp. nov.

Characters as given in the generic synopsis, combining some of the characters of *Pythamus* and *Nirvana* and yet widely distinct from both. It is in many respects a connecting link between them.

Pythonirvana muiri sp. nov. Plate 5, fig. 44.

Shining black; venter with lateral abdominal margins (except subgenital plate and genitalia), legs, and antennæ pale ochraceous; a small oval yellow spot next to margin on either side of vertex halfway between ocellus and apex; a large triangular lemon yellow spot at middle of clavus, its long side on the

commissure; toward apex of tegmina the black becomes deep fuscous. Length, female, 5.5 millimeters; male, 5.

Head from above with the appearance somewhat of *Nirvana*, but viewed from side deep throughout, the lower frontal line concave. Length of face (Plate 5, fig. 44, c) one and two-thirds times the width, the front more than two times longer than wide; clypeus strongly narrowed to apex; loræ minute. Front rugose-punctate on the concave apical half and coarsely obliquely wrinkled on the strongly protuberant basal half. Supra-antennal carina strong, oblique, and some distance above insertion of antennæ, the supra-antennal area smooth; basal lateral areas of face with the lateral oblique folds strongly carinate, one of these carinæ extending toward upper margin of eye, closely subtending the ocellus, and joining bordering carina near eye, leaving between it and the bordering carina a deep narrow lateral sulcus in which the ocellus is located, the latter some five or six times its diameter from eye. Length of vertex (Plate 5, fig. 44, a) a little less than twice interocular width, surface deeply concave, a little raised toward median line where there is a strong uniform median carina reaching to near apex; the bordering carina is sharp, strongly raised, incurved above ocellus, and continuous with lateral carina to base of eyes, the obtuse lateral folds of *Nirvana* being here high and sharp; interior surface smooth, except for scattered punctures, and irregular wrinkles on lateral slopes; basal margin of vertex not carinately raised; lateral margins parallel. Length of pronotum into vertex one and a half times, the anterolateral margins distinctly longer than posterolateral, into width three and a half times; hind margin broadly subangularly emarginate; larger part of surface very coarsely transversely rugose-punctate, coarsely punctate apically and with two small smooth areas behind eyes. Median basal area of scutellum coarsely rugose-punctate, apical area minutely rugose. Basal portion of clavus and base of subcostal area closely coarsely punctate; veins bordering radial and medial areas distinct except at base; first, second, and third cells regularly gradated in length, the third shortest; one oblique cross vein in subcostal area. Head much narrower than pronotum.

BORNEO, Sandakan (*Baker*). AMBOINA (*Muir*). The single specimen taken by Mr. Muir in Amboina is identical with the Sandakan specimens. With the narrow head and the coarse sculpture, this has a remarkable resemblance to *Pythamus*, and yet it is properly one of the *Nirvaniidæ*.

Genus JASSONIRVANA novum

Type, *Jassonirvana lineata* sp. nov.

Characters as given in the generic synopsis. Having somewhat the appearance of a small *Neocoelidea* of the Jassini, but indubitably a member of this family. Its appearance from above is not unlike that of a *Macroceratogonia*.

Jassonirvana lineata sp. nov. Plate 5, fig. 45.

Very pale ochraceous; two complete sublateral longitudinal orange bands on vertex are extended caudad to hind margin of pronotum; a broad median band on vertex, a broad median and two sublateral bands on pronotum ivory white, the latter extending caudad within claval suture to half the length of clavus; a broad orange band passes from base to apex of clavus next the commissure; corium and membrane subhyaline, the former slightly tinged with ochraceous. Length, female, 4.25 millimeters; male, 3.5.

Face (Plate 5, fig. 45, c) as broad as long, eyes very large; loræ long and very narrow; front broadly flattened except at base where it is strongly convex below apex of vertex; surface shagreened; median carina confined to apical half. Supra-antennal carina weak and strongly curved. Basal lateral areas of face roundly convex, entirely without frontal folds or wrinkles. Anterior margin of vertex entirely without bordering carina, the vertex being smoothly rounded on to face; ocelli on this rounded border a little within the lateral border of crown as seen from above and about three times their diameter from eye. Length of vertex (Plate 5, fig. 45, a) one and a half times interocular width, strongly narrowed between the deep-set eyes, the lateral margins of head in front of eyes straight for a short distance, then oblique to the obtuse-angulate apex; surface of vertex evenly gently convex, shagreened, sides and base without raised margins. Length of pronotum a fifth greater than length of vertex, anterolateral margins subequal to posterolateral and into width about four times; surface smooth with some faint indications of cross wrinkling on median basal area. Scutellum much shorter than pronotum, surface smooth. Several rows of coarse pit punctures on basal part of corium; clavus opaque; corium translucent, entire apical area hyaline; a transverse cross vein (Plate 5, fig. 45, d) near apex of subcostal area, and just before this an indication of a very oblique cross vein which joins the former at base; venation peculiar in that all the apical cells are strongly narrowed to base and all bordering on the radial

area; marginal vein outwardly at apex extraordinarily thickened; appendix well developed. Subgenital plate of female with hind margin deeply broadly incurved.

LUZON, Laguna Province, Los Baños and Mount Maquiling (*Baker*): Bataan Province, Mount Limay (*Baker*).

STENOMETOPIINÆ

Genus STENOMETOPIUS Matsumura

Matsumura, Journ. Coll. Agr. Sapporo 5 (1914) 217.

Type, *Stenometopius formosanus* Matsumura.

Head broadly laminately extended but thick dorsoventrally; vertex between three and four times as long as interocular width; eyes deeply set in vertex; posterior margin of pronotum nearly straight; sides of clypeus subparallel; pronotal lateral carinæ wanting; temples narrow; antennæ inserted close to and between eyes; tegmina with two subapical cells; ocelli beneath border of vertex and not visible from above.

Through *Pythonirvana* and *Jassonirvana*, the relationship of this genus to *Nirvana* is indicated. Whether or not *Stenometopiellus* Haupt³⁴ has any close relationship with *Stenometopius* I do not know. Of his genus Haupt described one species, *sigillatus*, from Buchara.

Synopsis of species.

- α^1 . Median area of tegmina shorter, length about five times width; first anteapical cell outside radius (as figured) very small, about half the length of second..... *S. formosanus* Matsumura.
- α^2 . Medial area of tegmina very long, length more than seven times the width; first anteapical two-thirds the length of second and directly following the radial area..... *S. mindanaoensis* sp. nov.

Stenometopius mindanaoensis sp. nov. Plate 5, figs. 46 and 47.

Sordid ochraceous, spotted and banded with brownish; two oblique bands across pleuræ and two oblique stripes on each ventral segment dark brownish; two small oblique stripes on sides of face, the lower part of front, and a curved stripe along its basal border pale brown. Vertex with two oblique pale brown stripes on either side of anterior half; a reddish stripe starts from the margin in front of eyes, curves caudad, passes near eye, and indistinctly crosses pronotum and basal angles of scutellum; median carina of vertex whitish anteriorly, brownish posteriorly. Tegmina translucent, the subcostal area,

³⁴ Wien. Ent. Zeit. 36 (1917) 251.

outer subapical cell, and fourth apical cell largely albescent with brownish margins; apical veins broadly white. Length of female, 5 millimeters.

Face (Plate 5, fig. 46, *c*) twice as long as broad; the basal lateral sutures of front beyond antennæ not distinct, the strong margins shown in the figure being not the sutures but the strongly marked limits in facial view of the lower concave shagreened portion of front, which basally is strongly narrowed into the laminately compressed basal portion, the sides of which are smooth. Antennæ inserted close to middle of eye margin, not in an excavated scrobe, and without a supra-antennal ledge or carina. Ocellus small, a little farther from border of vertex than from eye, and without wrinkles or carinæ in its vicinity. Vertex (Plate 5, fig. 46, *a*) three and three-fourths times as long as interocular width, broadly spatulate in outline, sides passing forward from outer line of eye, obtuse-angulate at apex; lateral areas gently depressed, basal two-thirds shagreened, apical one-third longitudinally wrinkled. Claval veins strong and prominent; venation as shown in Plate 5, fig. 47. Subgenital plate of female truncate.

MINDANAO, Davao Province, Davao: Bukidnon Province, Tangkulan (*Baker*). Described from Formosa and also found in Mindanao, representatives of this remarkable genus will doubtless also be found in the intervening islands.

ILLUSTRATIONS

PLATE 1

- FIG. 1. Hind tarsi of various Jassoidea. *a*, *Onukia muirii* sp. nov.; *b*, *Pythamus melichari* Baker var. *borneensis* var. nov.; *c*, *Stenometopius mindanaoensis* sp. nov.; *d*, *Preta luzonensis* sp. nov.; *e*, *Stenotortor inocarpi* sp. nov.; *f*, *Paropia scanica* Fall.
2. *Kyphocotis tessellata* Kirkaldy; *a*, tegmen; *b*, face; *c*, profile of head.
3. The face in *Koebelia*, *Ulopa*, and *Paropia*. *a*, *Koebelia californica* Baker, face; *b*, *Ulopa trivia* Germ., face, frontal view; *c*, *Ulopa trivia* Germ., face, lateral view; *d*, *Paropia scanica* Fall., face, frontal view; *e*, *Paropia scanica* Fall., face, lateral view.
4. *Signoretia maculata* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
5. *Signoretia carinata* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
6. *Signoretia bilineata* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
7. *Signoretia benguetensis* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face; *d*, tegmen.
8. *Preta gratiosa* Melichar; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
9. *Preta luzonensis* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
10. *Euacanthus interruptus* Linnæus (Japan); *a*, head and thorax, dorsal view; *b*, head and pronotum, lateral view; *c*, face.

PLATE 2

- FIG. 11. *Pythamus productus* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, side view; *c*, face.
12. *Pythamus decoratus* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
13. *Pythamus melichari* Baker var. *bilobatus* var. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
14. *Pythamus melichari* Baker var. *singaporensis* var. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
15. *Pythamus melichari* Baker var. *borneensis* var. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face; *d*, tegmen.
16. *Onukia onukii* Matsumura; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face; *d*, tegmen.

- FIG. 17. *Onukia corporaali* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head, lateral view; *c*, face.
18. *Onukia muirii* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head, lateral view; *c*, face; *d*, tegmen.
19. *Onukia kelloggii* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
20. *Oniella leucocephala* Matsumura; *a*, head and pronotum, dorsal view; *b*, head, lateral view; *c*, face; *d*, tegmen.

• PLATE 3

- FIG. 21. *Balbillus albellus* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face; *d*, tegmen.
22. *Stenotortor inocarpi* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
23. *Stenotortor inocarpi* sp. nov. Tegmen.
24. *Kana illaborata* Distant; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face.
25. *Kana illaborata* Distant; *a*, tegmen; *b*, wing.
26. *Kana picea* sp. nov.; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face; *d*, tegmen.
27. *Kana maculata* sp. nov.; *a*, head and pronotum, dorsal view; *b*, tegmen.
28. *Kana anomala* sp. nov.; *a*, head and pronotum, dorsal view; *b*, tegmen.

PLATE 4

- FIG. 29. *Nirvana placida* Stål, female; *a*, head and pronotum, dorsal view; *b*, head and pronotum, lateral view; *c*, face; *d*, tegmen.
30. *Nirvana placida* Stål, male; *a*, head and pronotum, dorsal view; *b*, tegmen.
31. *Nirvana philippinensis* sp. nov., male; *a*, head and pronotum, dorsal view; *b*, tegmen.
32. *Pseudonirvana ocellaris* sp. nov.; *a*, head and pronotum, dorsal view; *b*, tegmen.
33. *Pseudonirvana penangensis* sp. nov.; *a*, head and pronotum, dorsal view; *b*, tegmen.
34. *Pseudonirvana singaporensis* sp. nov.; *a*, head and pronotum, dorsal view; *b*, tegmen.
35. *Pseudonirvana malayana* sp. nov.; *a*, head and pronotum; *b*, tegmen of male.
36. *Pseudonirvana sandakanensis* sp. nov.; *a*, head and pronotum, dorsal view; *b*, tegmen.
37. *Pseudonirvana davaoensis* sp. nov.; *a*, head and pronotum, dorsal view; *b*, face, lateral view; *c*, tegmen.
38. *Pseudonirvana sanguineolineata* sp. nov.; *a*, head and pronotum, dorsal view; *b*, tegmen.
39. *Pseudonirvana longitudinalis* Distant; *a*, head and pronotum, dorsal view; *b*, tegmen.

PLATE 5

- FIG. 40. *Ophiuchus basilanus* sp. nov.; a, head and pronotum, dorsal view; b, head and pronotum, lateral view; c, tegmen.
41. *Ophiuchus montanus* sp. nov.; a, head and pronotum, dorsal view; b, head, lateral view.
42. *Ophiuchus marginatus* sp. nov.; a, head and pronotum, dorsal view; b, head, lateral view; c, tegmen.
43. *Nirvanoides amboinensis* sp. nov.; a, head and pronotum, dorsal view; b, head and pronotum, lateral view; c, tegmen of male; d, tegmen of female.
44. *Pytho-nirvana muii* sp. nov.; a, head and pronotum, dorsal view; b, head and pronotum, lateral view; c, face; d, tegmen.
45. *Jassonirvana lineata* sp. nov.; a, head and pronotum, dorsal view; b, head and pronotum, lateral view; c, face; d, tegmen.
46. *Stenometopius mindanaoensis* sp. nov.; a, head and pronotum, dorsal view; b, head and pronotum, lateral view; c, face.
47. *Stenometopius mindanaoensis* sp. nov.; tegmen.

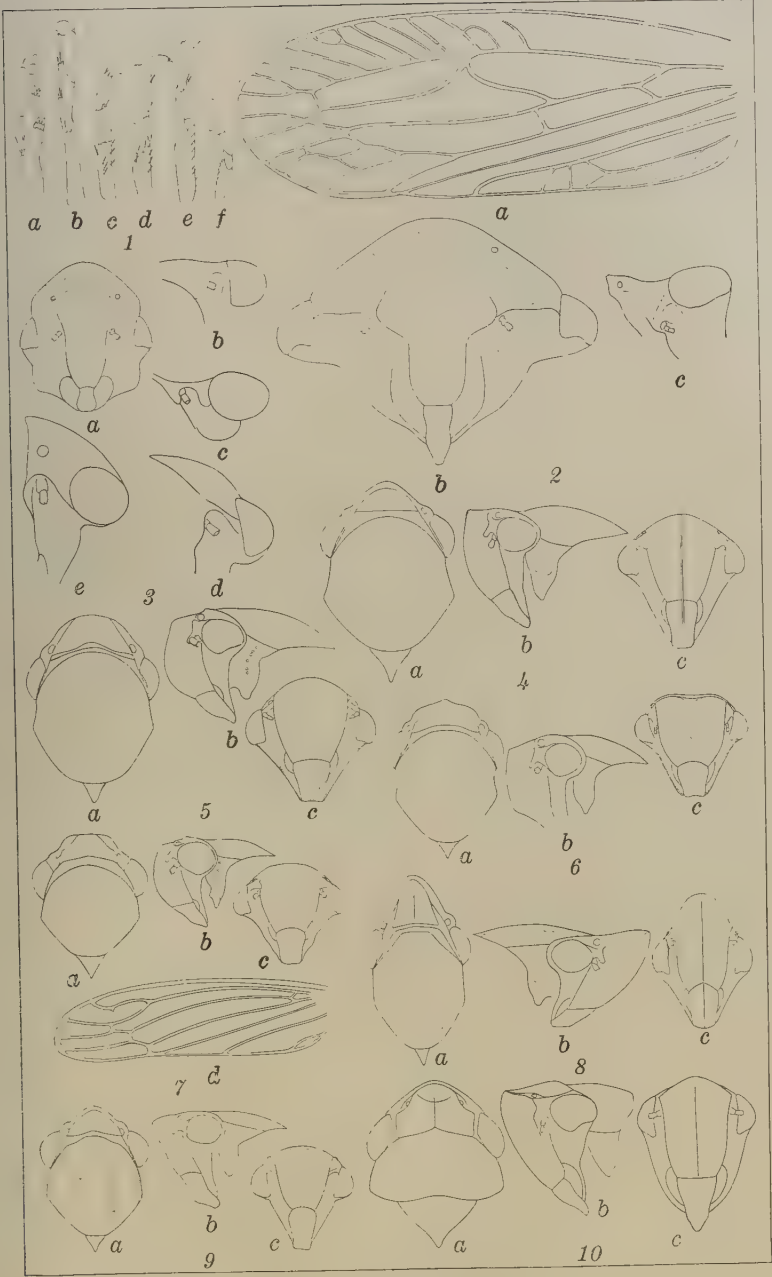


PLATE 1.

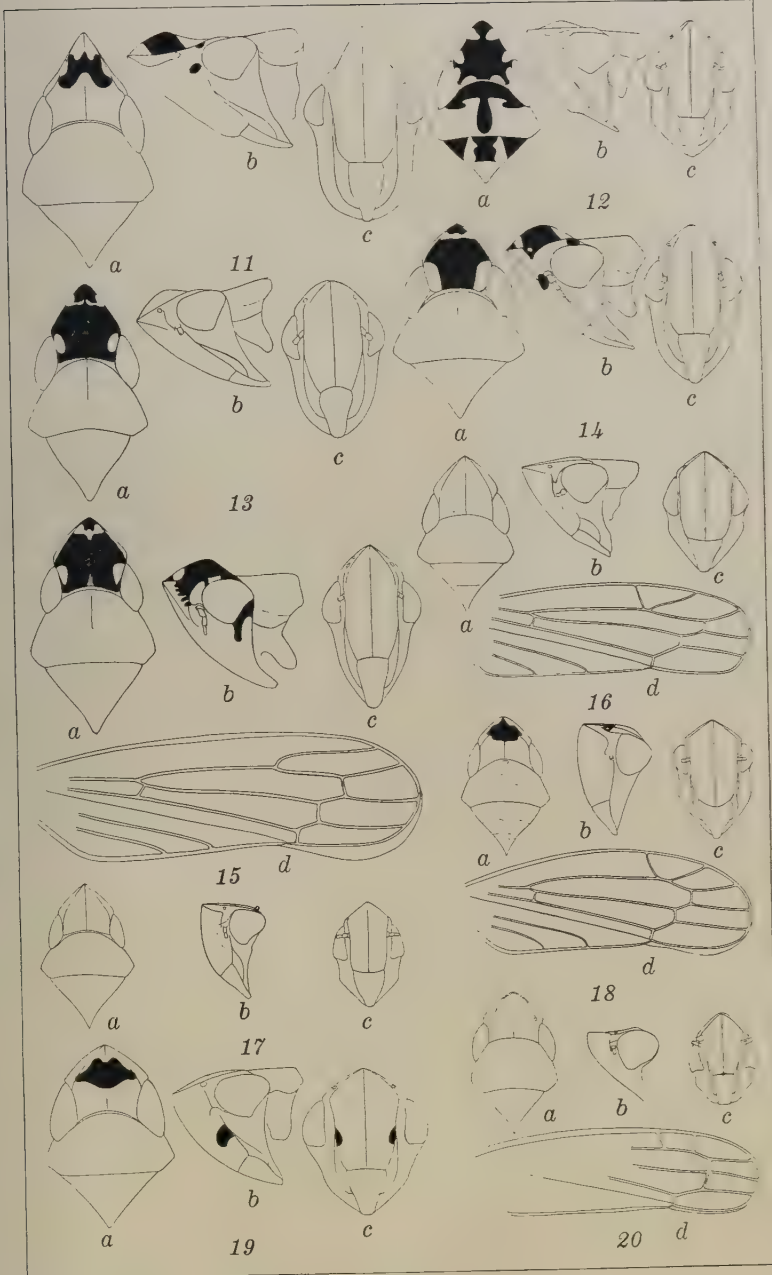


PLATE 2.

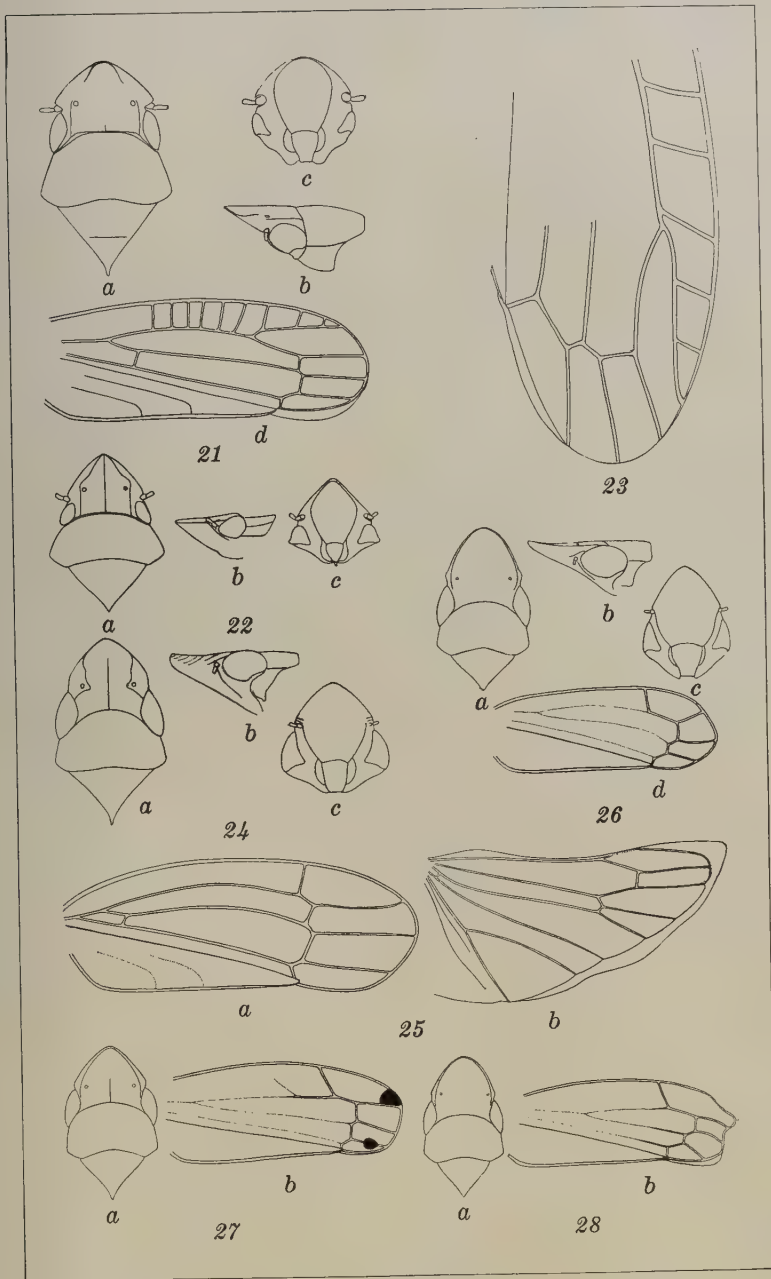


PLATE 3.

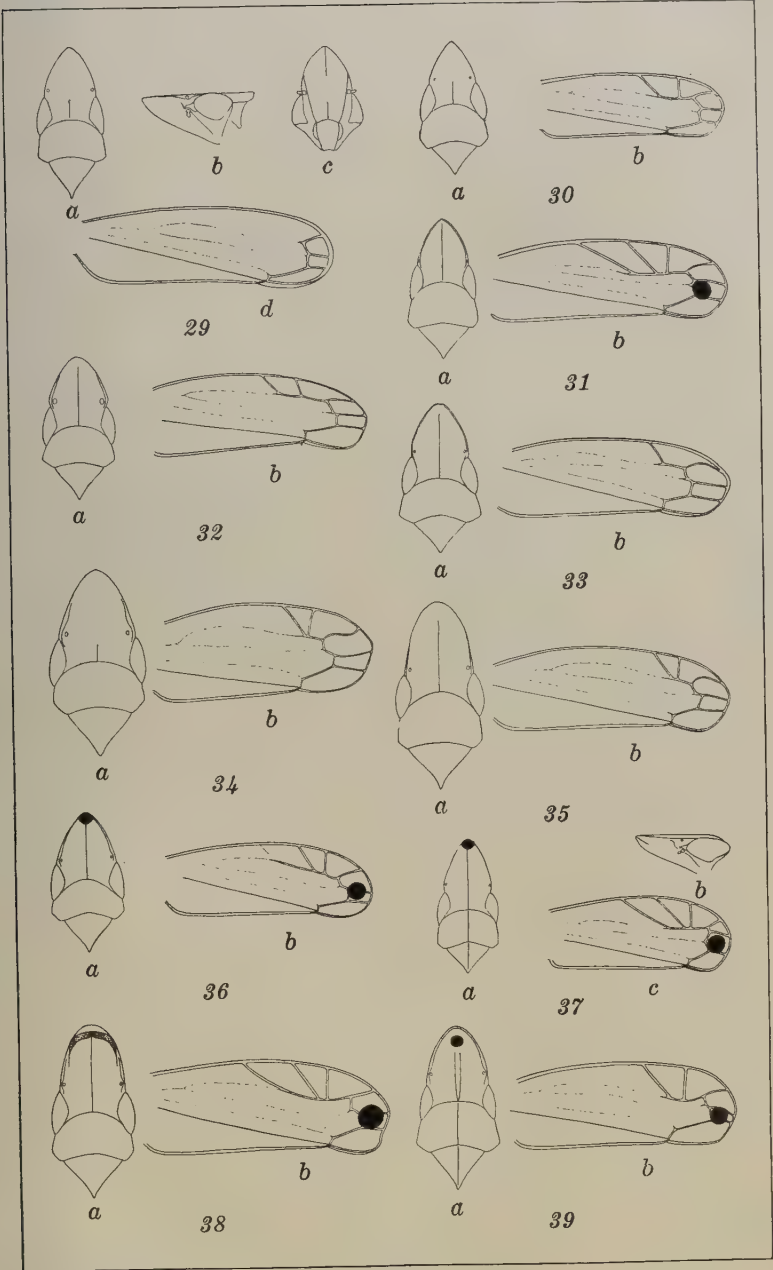


PLATE 4.

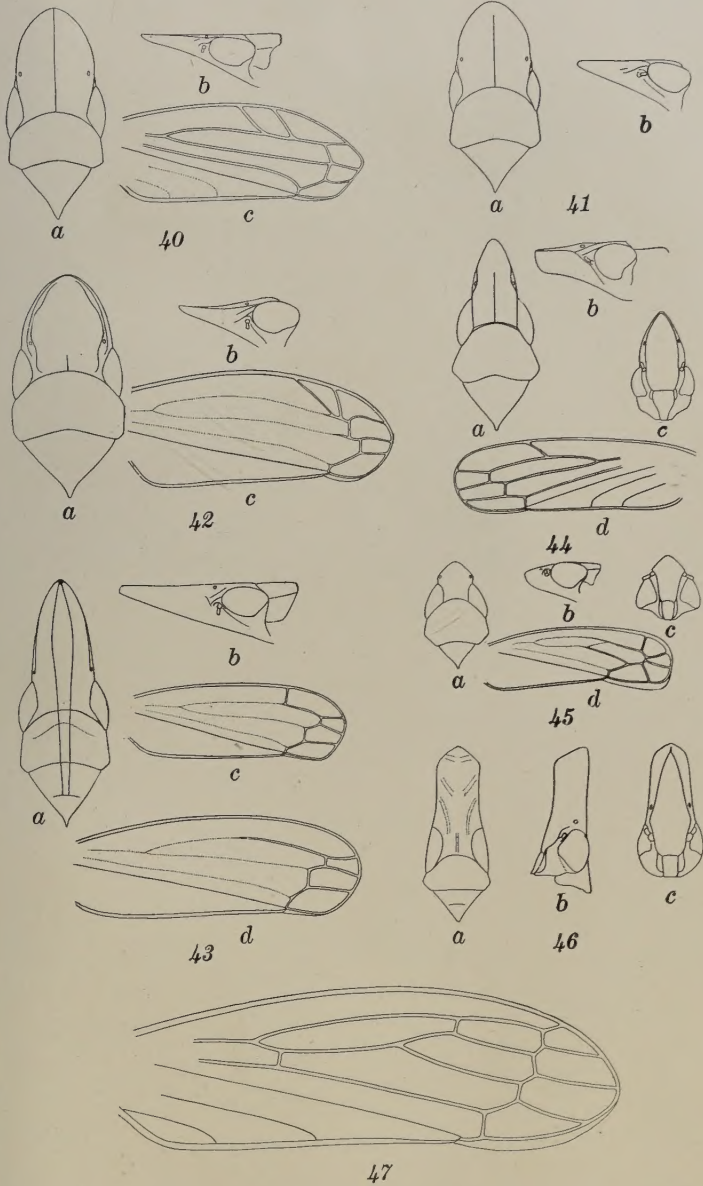


PLATE 5.

